

Current Vegetation Survey

Natural Resource Inventory
Pacific Northwest Region
USDA Forest Service
Portland, Oregon
Version 1.5
1995®

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Introduction

The Current Vegetation Survey is a permanent plot grid system (3.4, 1.7 mile ...) that samples the range of vegetative conditions across all proclaimed National Forest lands in Region Six. This permanent plot grid will provide resource information to meet Resource Planning Act (RPA) and Pacific Northwest Station's Forest Inventory and Analysis (FIA) requirements on a regional and national basis.

The sample unit design encompasses 1 hectare (2.5 acres). Five sample points identify the ground location where data collection begins. Subplots of various sizes, installed in conjunction with each sample point, sample existing vegetation. The vegetation information collected includes live tree, dead tree, plant indicators, down woody material. Intensive measurement of the vegetation provides the means of recreating each item from the database.

The procedures in this manual describe the information being collected and are in the same general sequence as implementation. Instructions are in four parts. Part 1, Sample Unit Establishment describes the steps necessary to locate sample point 1 and reference the sample unit. Part 2, Sample Unit Design & Establishment, describes the steps necessary to locate, installation and reference sample points. Part 3, Tally Requirements, describes requirements associated with but not specific to vegetative data collection. Part 4, Appendix, supplies examples and supporting documentation for this survey.

The following items are not included in this survey: Survey Type, Previous Tree Number, Reconciliation, Debris Depth, and Features.

Part 1: SAMPLE UNIT ESTABLISHMENT

Project area maps, field data forms, and aerial photographic reproductions (aerial photos) are needed to locate and install sample units. The project area map will provide road access information to the area covered by the aerial photos. Primary aerial photos have sample point 1 pinpricked and circled. Sample point 1 is where installation of the sample unit will begin.

Photo Determination

Computed, Trial and Error, and Reference by Inspection are methods used for determining azimuth and distance from Supplemental Reference Point (SRP) to Reference Point (RP), or RP to sample point 1.

The Computed and Trial and Error methods combine photo and ground measurements to calculate photo azimuth, photo distance, and photo scale. Photo measurements are converted to a ground scale to determine the actual direction and distance to travel from an SRP to RP, or RP to sample point 1.

Establish ground and photo baselines to obtain azimuth and distance information. Baseline ends shall be identifiable on the ground and on an aerial photo. Pinprick the ends of the photo baseline and enclose each pinprick in a square. Identify the ground baseline ends with flagging (In **Wilderness areas**, do not use flagging, drive wood stakes into the ground at the start and finish of the baseline). All baselines shall be near the same elevation as the sample unit and 660 feet long or longer.

Photo azimuth is determined by taking a compass reading along a line that bisects the ends of the ground baseline. Transfer the azimuth measurement to the photo baseline.

Photo scale is determined using the following procedure:

Computed method: Determine photo scale by the relationship between ground and photo distances measured between baseline ends. Measure the horizontal distance between the ends of the ground baseline. Then measure the distance between the ends of the baseline on the photo. Use the following procedure to determine photo scale:

$$\text{Photo Scale Reciprocal} = \frac{\text{Ground distance (feet)} \times 12}{\text{Photo distance (inches)}}$$

Example: Ground distance = 1,475 feet
Photo distance = 1.26 inches

$$\text{Photo Scale Reciprocal} = \frac{1,475 \times 12}{1.26} = 14,047$$

Photo Scale = 1:14,047

Trial and Error method: Fit a multiple photo scale rule to a line (baseline) on the photo of known ground or map distance. Find the photo scale that registers the same distance between points for the ground or map distance. Ground or map distance must be in the same units as the photo scale. Determine horizontal ground distance directly by measuring the distance between two points on the photo and reading the corresponding ground distance from the scale.

Reference Azimuth and Distance

Once the baseline azimuth, photo distance and photo scale are known azimuth and distance between any two points can be calculated. Use the following procedure to calculate the azimuth and distance between two points (i.e., RP to sample point 1):

Extend a line drawn between the pinprick location of the RP and sample point 1 until it intersects an extension of the baseline. If the two lines do not intersect, draw a secondary baseline in any convenient direction between the two. Determine the true azimuth of the secondary baseline from the first baseline. Use the secondary baseline to get the azimuth of the RP to sample point 1 line.

Lay the center of a circular protractor over the intersection of the line of known azimuth and the RP to sample point 1 line. Turn the protractor so the known azimuth line (baseline) is directly beneath the same azimuth on the protractor.

Read the azimuth of the RP to sample point 1 line directly off the protractor.

Using the local photo scale calculate the horizontal ground distance. Multiply the photo distance (in.) between the RP and sample point 1 by the photo scale, then divide the resultant by 12 to get horizontal ground distance in feet. Install a ground traverse from the RP to sample point 1 using the azimuth and distance calculations from the photo.

Upon completion of the prescribed ground traverse, examine the photos to verify arrival at the desired pinprick location. If the ground location at the end of the traverse is not the same as the pinprick, adjust from the end of the traverse to coincide with the actual pinprick location. Record this adjustment in the Route to RP portion of the identification form.

Note: When working on the back of the photo it is necessary to invert the protractor.

Reference by Inspection

Use direct ground measurements from sample point 1 to a Reference Point tree. Locate and mark the location of the photo pinprick (sample point 1) with a stake in the ground. Select a reference point tree identifiable on the ground and on the photo. Pinprick the photo to identify the location of the RP tree. Measure the azimuth and distance on the ground from the RP to sample point 1 and monument the RP according to manual directions. Record all information on the appropriate forms and on the back of the primary photo. Note the sample unit was "referenced by inspection". Install Supplementary Reference Points (SRP) in the same manner when necessary.

Sample Unit References

One Reference Point (RP) is required for every sample unit. Establish each reference point within 900 feet of sample point 1. Under no circumstances shall the reference point serve as one of the Sample Point References (SPR) for any sample point. Select a reference point that is easily photo identifiable, re-locatable within ten years and accessible from the ground. Select a live tree as a reference point over all other objects. When a live tree or other acceptable photo identifiable object is not available for a reference point install a post (dimensions: 6' tall by at least 2" wide) as the reference point. The post shall be orange in color and located on a prominent geographical feature, within 900 feet of sample point 1. The installed post shall be accessible from the ground and re-locatable within ten year.

Supplemental Reference Points (SRP) are installed when the "Route to RP" narrative is unclear in directing a crew to the Reference Point. Direct measurements (azimuth and distance) are used to guide crews from SRP to SRP, or SRP to RP.

Record the following information on the back of the primary photo and in RP and/or SRP Information on the Identification Form for each RP and SRP used: **Species** (Appropriate specie code), **DBH** (Measure to the last whole inch), install a DBH nail as described in tree diameter, **Azimuth** (Measure to the nearest degree from SRP to SRP, SRP to RP, or RP to sample point 1), **Distance** (Measure to the nearest horizontal foot from the SRP to SRP, SRP to RP or RP to sample point 1).

Select -- Trees 5 inches or larger in diameter as RP and SRP. Other objects suitable as reference points include (but not limited to) large stumps, distinctive fence corners, and structure corners. When an object is chosen over a tree for a Reference point reference, justify its use and clearly describe it in remarks.

Pinprick -- the base of any tree or photo identifiable object used for RPs, SRPs and baselines on the primary photo. If the base is not visible, pinprick the photo where the base appears to be (use crown position and shadow as aids). For installed RP posts pinprick the approximate location. Pinpricks shall not obliterate the item being referenced (i.e., pinprick holes should not exceed .025" dia.). On the back of the photo draw a: circle around RP pinpricks; triangle around SRP pinpricks and a square around baseline pinpricks as shown:



RP



SRP



Baseline

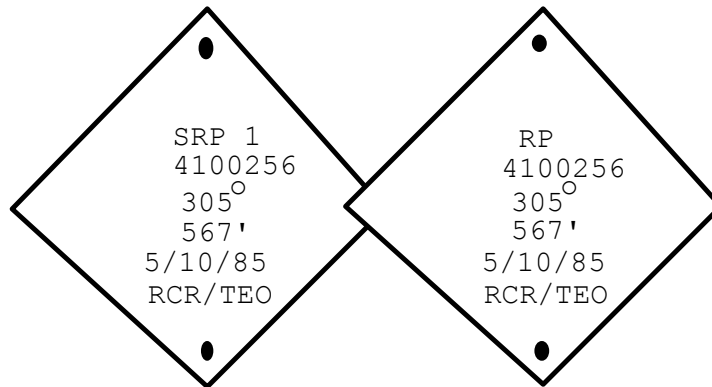
Mark -- All RP and SRP trees with a 5-inch square diamond blaze above 4.5 feet or eye level (whichever is higher). The blaze should face the likely avenue of approach, except along designated roadways or high use recreation trails. Blaze trees along these roadways or trails on the opposite side. Note "Blaze on Back" in the route to RP section. Do not mark RP posts with a diamond blaze. In **Wilderness areas** -- Do not mark SRP or RP references with diamond blazes.

Scribe -- The following information on the aluminum tag with a ball point pen:

Symbol	RP or SRP
Sample unit number	7 digit number
Azimuth	Nearest degree from this sample unit reference to next reference or sample unit
Distance	In feet (horizontal) from this sample unit reference to next reference or to sample unit center
Date of establishment	Date installation started
Initials	Initials of both field installers

SRP/RP TAG

Symbol
Sample Unit Number
Azimuth (To plot RP from SRP)
Horizontal Distance (RP to SRP)
Date
Initials



In **Wilderness areas** -- Use anodized or painted aluminum tags to blend with surrounding vegetation.

Attach -- Two square aluminum reference tags to all RP and SRP references. Place one tag to face in the direction of the traverse being referenced and the other to face a likely avenue of approach. Use two nails and solidly affix the tags to the base of a reference tree. Locate the tag 12 inches or less above the ground. Chop away excess bark (Do not chop into the cambium layer) to solidly affix tags to wood, leaving 1/2 to 3/4 of nail exposed. When post is used as the RP wire the aluminum tags to the post.

Part 2: SAMPLE UNIT DESIGN & ESTABLISHMENT

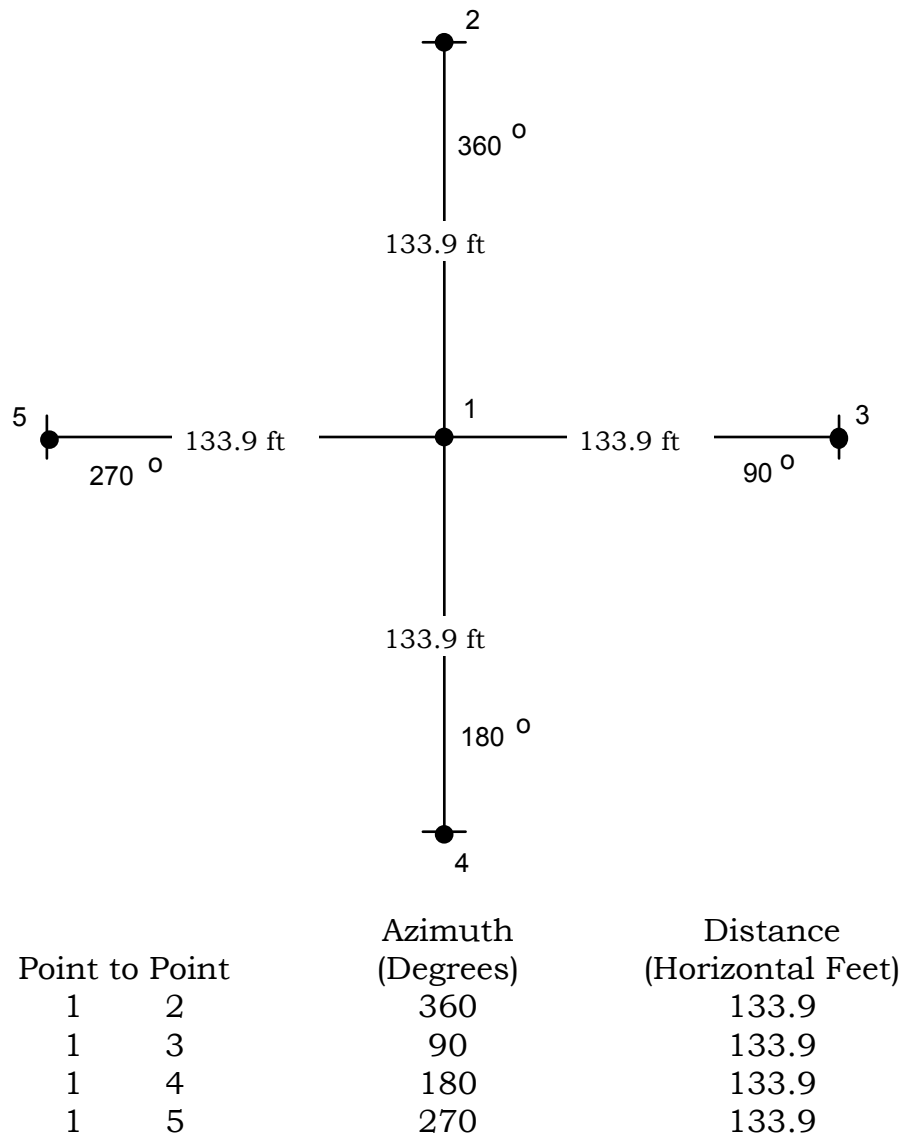
This following describes establishment of the sample unit, establishment and referencing sample points' 1-5, and subplot/transect emanation around each sample point.

Sample Unit Establishment

Do not install any sample units if sample point 1 is in an inaccessible area (deep water, cliff) or on non-forest service lands.

Sample Point Establishment

Beginning at the site established from the reference traverse for sample point 1 locate and establish sample points 1 through 5 in ascending numerical order:



Marking Sample point Locations

Place a stake securely in the ground at each sample point center. Drive each stake 2/3 of its' length into the ground. Place rocks around the stake whenever they are available to add permanence. Drive an aluminum nail into the top center of all newly installed stake (this defines the center of the sample point).

When a post is installed as the RP a one foot long by 3/8" diameter piece of solid steel (rebar) shall be driven into the ground next to the sample point 1 stake. When a stake (and/or rebar) can not be securely driven into the ground a rock monument will be build around the stake (and/or rebar) to provide a solid foundation to secure them in place for a period of ten years.

Make every reasonable effort to locate each sample point in its standard position. When solid objects such as standing trees make establishment at the standard position impossible, make a shift in sample point placement. Offset sample points from their standard locations to the closest spot available for establishment. Note the offset and circumstances clearly in remarks.

Do not install subplot for any sample point (2 through 5) that falls in an inaccessible area (deep water, off a cliff) or on non Forest Service land. Record the appropriate sample point number on the vegetation data form and a zero (0) for the subplot number. When a sample point, 2-5, falls on Forest Service land but a portion of the subplot lies on non Forest Service land, tally only that portion on Forest Service land. Delineate the change in condition on the sample unit diagram and document the situation on the Identification Form under Present Condition/Past Disturbance.

To collect subplot data when the sample point is accessible but stake installation is impossible (roads, improvements, debris piles...) temporarily locate and mark the sample point center. Reference sample point center according to normal procedures.

Sample Point Reference (SPR)

Reference each sample point to three nearby objects. Use the guidelines listed below to select and reference each sample point:

Choose references that form, as close as possible, 120 degree angles with each other and center on the sample point stake. Choose references from the following list in descending order:

- A. Live tally trees 3.0" DBH and larger within 30 feet of the sample point stake.
- B. Sound dead trees, stumps or a photo identifiable item(fence post) within 30 feet of the sample point stake
- C. Live trees, dead tree, or stumps between 30 and 50 feet if sample point references are unavailable within 30 feet of the stake.
- D. If the above mentioned objects are not available use additional cedar stakes established 5 to 10 feet from the sample point. Explain the circumstance clearly in remarks.

Measure all reference azimuth and distance from the sample point center to the head of the nail in the reference object. In the case of a non-tally reference, measurements will be to the head of the nail. For tally items use the head of the number tag nail.

Sample point 1 references and all non-tally references shall have aluminum reference tags affixed to them, except where a stake is used as a non-tally SPR. On each tag scribe *Sample Unit Number, Sample point number, Azimuth, Distance, Installers Initials, and Date installed* in descending order. Attach the aluminum reference tag with two nails, below stump height, facing the sample point. If the sample point reference is a tally tree the tree number tags attaches to the bottom nail of the aluminum reference tag, between the nail head and aluminum reference tag.

When a stake is used as a non-tally reference a number tag shall replace the aluminum reference tag. A nail shall be used to affix the number tag to the top of the stake with the number facing up. The azimuth, distance, vegetation code, and diameter(of 0010) shall be recorded in the appropriate columns on the vegetation data and identification form. The tag number and "Ref" statement shall be recorded in the remarks column.

Record sample point 1 reference information on the identification form and within the body of the vegetation data form.

Sample point 2-5 tally references shall use existing tree number tags to denote the reference item(no aluminum tag is required). Non-tally references shall have a number tag affixed at DBH(or if shorter than DBH, at its highest point). When stakes are used as non-tally references follow the aforementioned procedures for a stake as a SPR. Record reference information for sample points 2 through 5 only on the vegetation data form. Record *Azimuth, Distance, Vegetation Code, Species, Diameter and Remarks* on the Vegetation data form for each sample point reference.

Record tally trees used as references in there tallied order. Record non-tally references after the fixed radius plots and before the line transect on each sample point. Record non-tally references as the first three line entries when no tally occurs on the sample point.

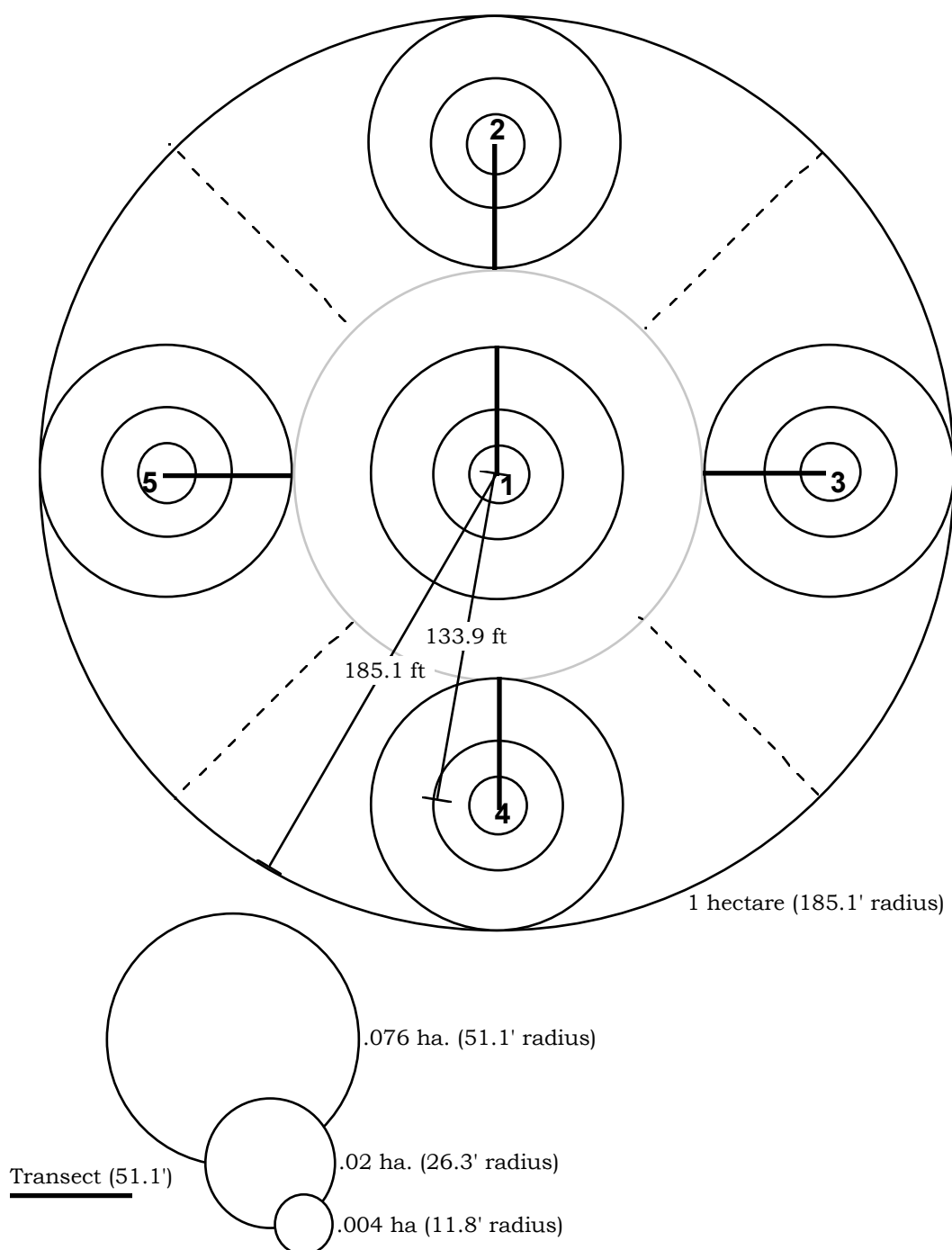
For all sample point references write "Ref" in the remarks' column opposite the object selected.

Orange tags

On sample point 1 attach two orange tags to each sample point reference. Locate These tags at a place above dbh (approx. eye level), with one tag facing the RP and one tag facing 180 degrees from the RP. Position the length of each tag parallel to the tree bole and affix with one or two nails leaving 1/2 to 3/4 of the nails left exposed. Attach orange tags only to trees used as sample point references. When trees are not available on sample point 1 for references select trees on the next sample point or sample points in succession until 3 sets of orange tags are installed. Note the location of the orange tags in remarks on the vegetation data card. Orange tags will not be used in **wilderness areas**.

SAMPLE UNIT DESIGN

The sample unit is a combination of sample point locations (1-5). Each sample point stake is a common center where subplots and line transects emanate. A variety of subplots tally live and dead vegetative information. Down Woody Material and Cover Class are tallied on line transects.



Three concentric fixed radius plots, .004 ha. (1/100 acre), .02 ha. (1/20 acre) and .076 ha. (1/5.3 acre) are established at each of the five sample points. An additional hectare (2.47 acres) is established at sample point 1. One line transect will be established at each of the sample points.

Subplot Establishment & Tally

Sample unit establishment begins at sample point one and continues in ascending order. Complete installation for the .076, .02, .004 hectare subplots and the line transect on each sample point before proceeding to the next sample point. The .076, .02, .004 hectare subplots and the line transects are established at each of the sample points before establishment of the 1 hectare subplot. Establish the .076, .02 and .004 hectare subplots beginning with the largest and continuing to the smallest. Establish line transects following the .004 ha. Subplot.

Forests and districts are designated as Eastside or Westside in the tally requirements' section. Tally sample units according to the eastside or westside designation.

1 hectare (185.1' radius) Fixed Radius Plot

Live & dead trees	32.0" dbh and larger (Eastside).
Live & dead trees	48.0" dbh and larger (Westside).

.076 hectare (51.1' radius) Fixed Radius Plot

Live & dead trees	13.0" - 31.9" dbh (Eastside).
Live & dead trees	13.0" - 47.9" dbh (Westside).
Stumps*	13.0" dbh and larger.

.02 hectare (26.3' radius) Fixed Radius Plot

Live & dead trees	3.0" - 12.9" dbh.
Stumps*	5.0" - 12.9" dbh.
Hardwood clumps	
Indicators species	
Root Disease Rating	

.004 hectare (11.8' radius) Fixed Radius Plot

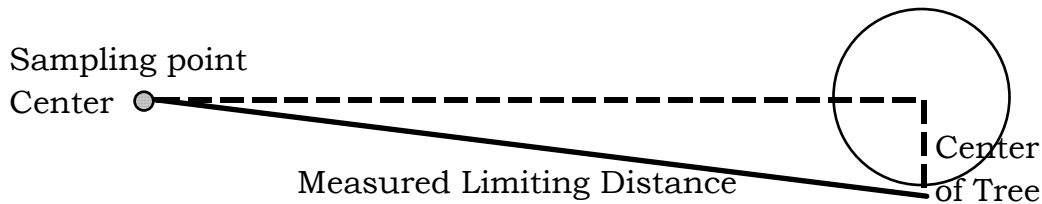
Live trees	1.0" - 2.9" dbh.
Dead trees & Hardwood stems	1.0" - 2.9" dbh. (group tally) by species.
Live seedlings	6" tall - .9" dbh (group tally) by species.

***-Record stumps as group tally only when there is evidence of root rot.**

Borderline Trees

To determine if a tree is "in" or "out" of a subplot measure the horizontal distance corresponding to that subplot radius. Check limiting distance with a measuring tape. Place a nail in the "center of the tree", where it enters the ground, perpendicular to a line from the sample point stake to the tree. Measure from above the nail in the sample point stake to the nail in the tree. Consider trees with limiting distance within the subplot radius to be "in".

Borderline clumps (or objects) shall have limiting distance measurements taken to the geometric center of the clump (or object) where it enters the ground.



Transects Establishment & Tally

Establish line transects at each of the sample points. Transects for subplot 2-5 will begin at the sample point and radiate towards sample point 1. The transect at sample point 1 will begin at the sample point center and radiate at 360°. Install the line transects following the .004 hectare subplot. Collect Down Woody Material and Cover Class information on each transect line:

Down Woody Material -- include uprooted tree boles and woody stems or branches. Tally only those pieces where the transect line crosses their central longitudinal axis and fifty percent or more of the piece is above the duff layer.

1. Tally each piece 3" intersect diameter (id) and larger along entire transect length. Record sequentially as individual line items.
2. Group tally 1.0"-2.9" id for the last 10 feet of transect length.
3. Group tally .2"-.9" id for the last 10 feet of transect length.

Cover Class: Record each cover type identified on the line transect as a separate line item. Record the accumulated distance that each cover type represents on the entire line transect.

Transect Installation

The Sample point stake represents the beginning of each transect line for Down Woody Material and Cover Class. Verify the azimuth used to establish each transect. Define the location of the transect by extending a tape along the designated azimuth from the sample point stake the adjusted .076 ha. radius distance. Pass the tape to either side of trees impeding a straight transect line (giving the least amount of offset). Install a stick with two feet of flagging at the end of each transect. Also hang two to three feet of flagging above the ending points at approximately eye level. The flagging at eye level will also help visualize the boundaries of the .076 ha. Subplot. Visualize the sampling plane passing along one edge of the tape and extending from the bottom of the litter layer to a specified height (six feet for down woody material and infinity for cover class) above the ground surface. Complete tally on the line transect before moving the tape. Record the sample point number, subplot number, vegetation code, and "000" in group tally when no tally occurs on a down woody transect. No flagging will be left in **wilderness areas**. Mark the ends of each transect in wilderness areas with a stake driven into the ground.

Part 3: TALLY REQUIREMENTS

Identification Form

Dash (-) out all unused data boxes on the Identification Form within completed line entries. Right justify all numeric and alpha/numeric fields (azimuth, distance, ect). Numeric fields shall contain leading zeros if necessary to complete entries.

Sample Type (8-digit)

Agency provided: Record Survey Type (AAA), Sample Design number (d), Documentation Version Number (nn) and Variation letter (v). For example (The current vegetation survey version 1.5, with no variations would be CVS1.50_).

Survey Date (6-digit)

Record the installation Month, Day, and Year as a numerical value. For example record a sample unit installed in June 12, 1992 as 06/12/92.

Photo Number

Agency provided: Record the photography roll number and photo number of the primary aerial photo for each sample unit. The primary photo is the one with sample point 1 pinprick on it. This number is in the upper right corner of the photo, e.g., 488-29.

Photo Date

Agency provided: Record the photography date (month/year) found in the upper left hand corner of the primary photo.

Sample Unit Number (7-digit)

Agency provided: The first digit identifies the grid type (3.4, 1.7 ...) for each sample unit. The remaining 6 digits are unique numeric identifier for each sample unit.

State & County (2-digit, ea.)

Agency provided: Record the appropriate code that identifies the State and County for each sample unit.

Oregon (41)

Code	County	East Dec.	Code	County	East Dec.	Code	County	East Dec.
01	Baker	20	25	Harney	20	49	Morrow	20
03	Benton	20	27	Hood River	21	51	Multnomah	21
05	Clackamas	21	29	Jackson	20	53	Polk	21
07	Clatsop	22	31	Jefferson	21	55	Sherman	20
09	Columbia	22	33	Josephine	20	57	Tillamook	22
11	Coos	20	35	Klamath	20	59	Umatilla	20
13	Crook	20	37	Lake	21	61	Union	20
15	Curry	20	39	Lane	20	63	Wallowa	20
17	Deschutes	21	41	Lincoln	21	65	Wasco	20
19	Douglas	20	43	Linn	20	67	Washington	21
21	Gilliam	20	45	Malheur	19	69	Wheeler	20
23	Grant	20	47	Marion	21	71	Yamhill	21

Washington (53)

Code	County	East Dec.	Code	County	East Dec.	Code	County	East Dec.
01	Adams	21	27	Grays Harbor	22	53	Pierce	22
03	Asotin	20	29	Island	23	55	San Juan	23
05	Benton	21	31	Jefferson	23	57	Skagit	23
07	Chelan	22	33	King	22	59	Skamania	21
09	Clallam	23	35	Kitsap	22	61	Snohomish	22
11	Clark	21	37	Kittitas	21	63	Spokane	21
13	Columbia	20	39	Klickitat	21	65	Stevens	22
15	Cowlitz	22	41	Lewis	22	67	Thurston	22
17	Douglas	22	43	Lincoln	23	69	Wahkiakum	22
19	Ferry	22	45	Mason	22	71	Walla Walla	21
21	Franklin	21	47	Okanogan	22	73	Whatcom	23
23	Garfield	21	49	Pacific	22	75	Whitman	21
25	Grant	21	51	Pend Oreille	22	77	Yakima	21

California (06)

Code	County	East Dec.
15	Del Norte	19
93	Siskiyou	19

Idaho (16)

Code	County	East Dec.
85	Idaho	19
49	Valley	19
03	Adams	19

Region/National Forest/District

Agency provided: Record the Region, Forest and District code identifying sample unit location. The first digit of each forest code represents the region number. The next 2 digits represent the forest number. East and West side conditions are indicated by (E) or (W) after each forest name. District deviation from the forest condition is also noted.

	Code		Code
Forest > Deschutes (E)	601	Forest > Fremont (E)	602
District: Bend	01	District: Bly	01
Crescent	02	Lakeview	02
Fort Rock	03	Paisley	03
Sisters	05	Silver Lake	04
Forest > Gifford Pinchot (W)	603	Forest > Malheur (E)	604
District: Mount St. Helens NVM	01	District: Bear Valley	01
Mt. Adams (E)	03	Burns	02
Packwood	04	Long Creek	03
Randle	05	Prairie City	04
Wind River	08		
Forest > Mt. Baker-Snoqualmie (W)	605	Forest > Mt. Hood (W)	606
District: Mt. Baker	01	District: Barlow (E)	01
Darrington	02	Bear Springs (E)	02
North Bend	05	Clackamas	03
Skyomish	06	Columbia Gorge	04
White River	07	Estacada	05
		Hood River (E)	06
		Zigzag	09
Forest > Ochoco (E)	607	Forest > Okanogan (E)	608
District: Big Summit	01	District: Tonasket	03
Paulina	02	Twisp	04
Prineville	03	Winthrop	05
Snow Mountain	04		
Forest > Olympic (W)	609	Forest > Rogue River (W)	610
District: Hoodspport	01	District: Applegate	01
Quilcene	02	Ashland	02
Quinalt	03	Butte Falls	03
Shelton	04	Prospect	06
Soleduck	05		

National Forest and District (cont.)

	Code		Code
Forest > Siskiyou (W)	611	Forest > Siuslaw (W)	612
District: Chetco	01	District: Hebo	01
Galice	02	Mapleton	02
Gold Beach	03	Alsea	03
Illinois Valley	04	Waldport	05
Powers	05		
Forest > Umatilla (E)	614	Forest > Umpqua (W)	615
District: Heppner	02	District: Cottage Grove	01
Pomeroy	04	Tiller	02
N. Fork John Day	05	Diamond Lake	03
Walla Walla	06	North Umpqua	06
Forest > Wallowa-Whitman (E)	616	Forest > Wenatchee (E)	617
District: Baker	01	District: Chelan	02
Wallowa Valley	02	Cle Elum	03
Hells Canyon NRA	04	Entiat	05
Eagle Cap	05	Lake Wenatchee	06
La Grande	06	Leavenworth	07
Pine	07	Naches	08
Unity	09		
Forest > Willamette (W)	618	Forest > Winema (E)	620
District: Blue River	01	District: Chemult	01
Sweet Home	03	Chiloquin	02
Detroit	04	Klamath	03
Rigdon	05		
Lowell	06	Forest > Colville (E)	621
McKenzie	07	District: Colville	01
Oakridge	08	Kettle Falls	02
Forest> Nez Perce (E)	117	Newport	03
District: Salmon River	03	Republic	04
(Slate Creek)	(01)	Sullivan Lake	05
		Forest> Payette (E)	412
		District: Council	01
		Weiser	02
		New Meadows	03

Proclaimed Ownership (3-digit)

Agency provided: Record the Region/Forest code that identifies ownership by territorial boundary of the sample unit.

Administered Ownership (3-digit)

Agency provided: Record the Region/Forest code that has administration authority of the sample unit area.

Universal Transverse Mercator (UTM)

Agency provided: Record the UTM zone along with the Northing and Easting coordinates

Elevation (2-digit)

Agency provided: Record mean elevation above sea level of each sample unit. Elevation is recorded to the nearest 100 feet. Record 460 feet as 05; 6320 feet as 63, etc.

Physiographic Class

Record the number that best describes the geographical position of the sample unit with respect to Aspect, Slope and Physiography.

Aspect (3-digit)

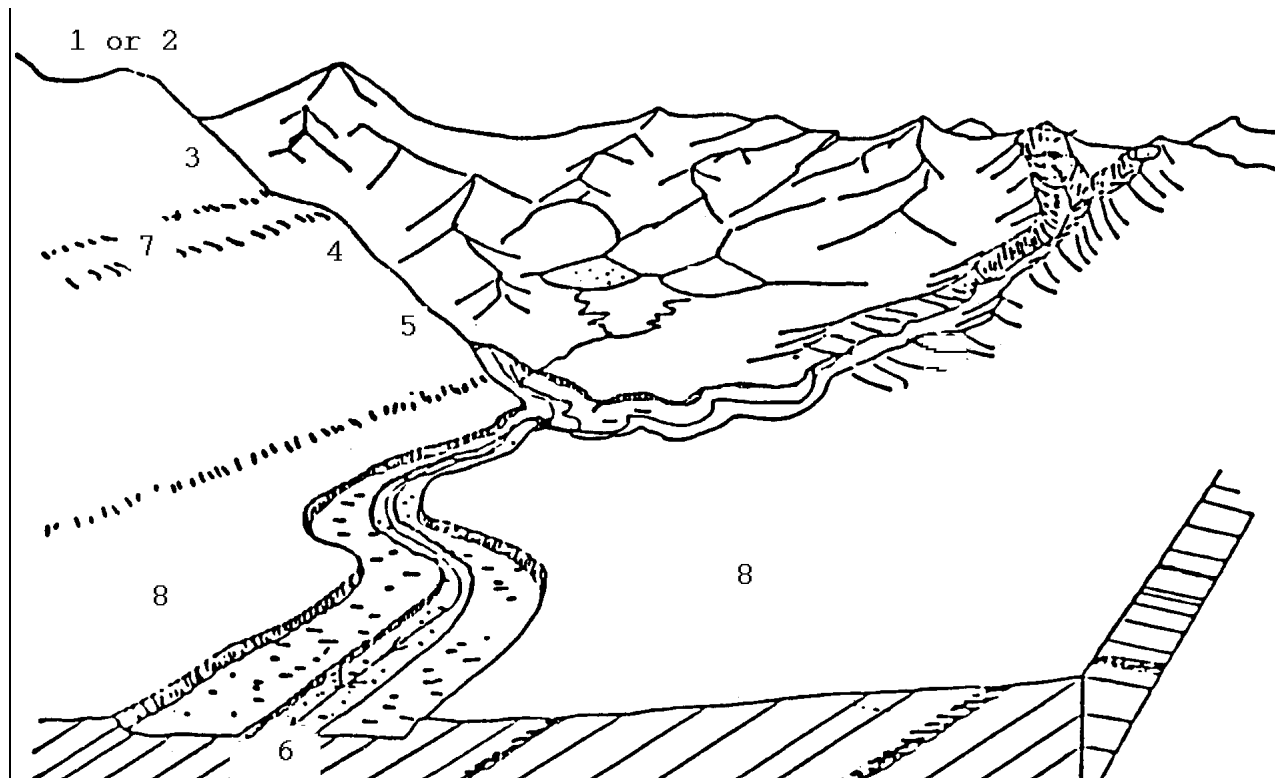
Aspect is the direction the sample unit faces with respect to true north. When variation in aspect occurs on the sample unit, weight the area to reflect the amount of variation of each condition. Record aspect in degrees from 001° to 360°

Slope (3-digit)

Slope is the amount of deviation from horizontal of the sample unit environment. When a distinct variation in slope occurs on the sample unit weight the area to reflect the amount of variation of each condition. Record slope in percent (%).

Physiography (1-digit)

Physiography Indicates the position of the sample unit in relation to major geological features. The vertical frame of reference is usually more than 1,000 feet.



Code	Physiography	Code	Physiography
1	Flat or rounded ridge top or peak > 120' wide	6	Canyon bottom less than 660 feet wide.
2	Narrow ridge top or peak < 120' wide	7	Bench or terrace
3	Sidehill - Upper 1/3	8	Broad flat 660 or more feet wide.
4	Sidehill - Middle 1/3	9	Other - describe in remarks
5	Sidehill - Lower 1/3		

Plant Association (6-digit)

Record the predominant plant association as determined from plant indicators on the .02 hectare subplot for each sample point. Plant association is a relatively discrete group of plants that maintain stable populations and occur over broad areas when similar environmental conditions exist. For more than one prominent plant association, sketch relative boundaries on the Sample Unit Diagram and label each. When a sample point (2-5) is not installable, record NOSMPT in Plant Association.

Root Disease Rating

Following a survey of the entire .02 hectare subplot on each of the sample points determine the Root Disease Severity Rating code that best describes the condition and degree of root disease within the area. Record the appropriate code listed below on the Identification Form for each sample point.

CODE

CRITERIA

- 0** No evidence of root disease visible within 50 feet of subplot.
- 1** Root disease present within 50 feet of subplot but no evidence of disease on subplot.
- 2** Minor evidence of root disease on subplot, such as a suppressed tree killed by root disease, or a minor part of the overstory showing symptoms of infection. little or no detectable reduction in canopy closure or volume.
- 3** Canopy reduction evident, up to 20 percent, usually as result of death of 1 codominant tree on an otherwise fully stocked site. In absence of mortality, numerous trees showing symptoms of root disease infection.
- 4** Canopy reduction at least 20 percent; up to 30 percent as a result of root disease-caused mortality. Snags, and downed trees removed from canopy by disease as well as live trees with advance symptoms of disease contribute to impact.
- 5** Canopy reduction 30-50 percent as a result of root disease. At least half of the ground area of subplot considered infested with evidence of root disease-killed trees. Subplots representing mature stands with half of their volume in root disease-tolerant species usually don't go much above severity 5 because of the ameliorating effect of the disease-tolerant trees.
- 6** 50-75 percent reduction in canopy with most of the ground area considered infested as evidenced by symptomatic trees. Much of the canopy variation in this category is generally a result of root disease-tolerant species occupying infested ground.
- 7** At least 75 percent canopy reduction. Subplots that reach this severity level usually are occupied by only the most susceptible species. There are very few of the original overstory trees remaining although infested ground is often densely stocked with regeneration of susceptible species.
- 8** The entire subplot falls within a definite root disease pocket with only one or very few susceptible overstory trees present.
- 9** The entire subplot falls within a definite root disease pocket with no overstory trees of the susceptible species present.

Present Condition/Past Disturbance

Record a lucid narrative description of the sample unit after installation and include relevant information about the sample unit. It shall contain information about any past disturbances (natural or human) that have modified the present composition and/or abundance of tree and ground vegetation occupying the sample unit. Note the absence of disturbance as well as any past disturbance.

Address items with relevant characteristics that describe the past disturbances and present conditions found on the sample unit. Below is a partial list of items to consider:

Slash disposal method.	Stoniness of soil and abundance of rock.
Cultural features.	Specific disease or insect problems.
Evidence of Fire	Evidence of domestic or wild animal use.
Recent thinning.	Openings and nonstockable areas.
Wind throw	Abundance and type of brush or distinctive ground cover.
Slope stability.	Conditions causing sample point not to be installed

Route to RP and Remarks

Record clear and concise directions from a permanent (easily located) starting point to the sample unit location. Identify the mode of travel (driving, hiking, ect.), Route followed (include road/trail designation number, compass bearing, ect.), and Distance traveled on each leg. Use cardinal directions (North, East, ect.) when identifying the route of travel. When changing the direction of travel select points of reference that are easily distinguishable and stand out from the surrounding environment. Monument references, when possible, to further distinguish them from similar items (i.e., tag at base of tree). Write Directions of travel in this space and on the back of the primary photo (e.g., appendix B).

SRP/RP Information

Record objects identified on a photo and referenced on the ground to provide assistance in relocating SRPs or an RP. Enter species (SPP), Diameter Breast Height (DBH), Azimuth (AZM) and Distance (DIST) of the object identified on the photo.

Sample Point 1 References

Record three objects referenced to sample point 1. Reference information shall include species (SPP), Diameter Breast Height (DBH), Azimuth (AZM), Distance (DIST).

Reference Form

Sample Unit Diagram

Accurately map the conditions of the hectare for each sample unit on the sample unit diagram. Delineate abiotic conditions: streams (class I - III), roads (improved and unimproved), rocky areas, major landform changes (cliffs, draws, ridges, ect.) and other items that show differences from their neighbors. Delineate biotic condition changes in: vegetation (type/specie/size/crown cover), plant ass., and management application (harvest activities, thinning, regeneration plantation, ect.) that differentiate themselves from adjacent areas. Label each condition or make a legend denoting delineated areas.

DBH Class: Use this table as a tatum aid to track GST selections by species (SPP) and diameter class at each sample point.

Vegetation Data Form

Record all line entries for each subplot or transect in consecutive order. After the last line entry of each sample point line out the next data line in red.

Make an entry in each field of a line item where tally is required. Evaluate the field and record the appropriate code. Zero (0) fill the field if no code is appropriate (e.g., for a live tree entry with no damage identified record 000 in the damage field; Where indicator species height is less than one foot 000 indicates an evaluation was made).

Dash-out (-) all unused data boxes on the Vegetation Data Forms within completed line entries.

Right justify all numeric and alpha/numeric fields (azimuth, distance, ect). Numeric fields shall contain leading zeros if necessary to complete entries.

Tree tally for each plot begins at 360 degree's azimuth and continues around the sample point center in a clockwise rotation. Record each vegetation code as a separate line entry on the Vegetation data form. Tally requirements vary by the size of each plot being established.

Out Of Order Tally

Record a tree 1" dbh or larger or a hardwood clump determined to be out of order (not in a clockwise sequence starting at 360°) on the next available line entry. Determine if tallied in its proper position it would affect the data collection of any previously recorded tree. If previously recorded information would change due to the out of order tree being tallied in its proper place (e.g., GST selection) correct the previous information to reflect the way it should have been recorded if the out of order tally had not occurred. Note in remarks appropriate "out of order" tally statement.

Azimuth (3-digit)

Record azimuth to the nearest degree from true north for sample point references, hardwood clumps, trees on the hectare greater than 83' from sample point one and trees tallied out of order. For the aforementioned determine azimuths from the sample point to the object being referenced.

Distance (3-digit)

All distance measurements will be horizontal unless otherwise noted. Measure Sample point References to the nearest tenth of a foot. Measure Cover Class and trees on the hectare within 83 feet of sample point 1 to the nearest foot. Record all distances in tenth of a foot (record 10' & 12.1' as 100 & 121 respectfully).

Sample point reference: Measure the slope distance from the sample point to the head of the nail affixing the tree tag number on tally trees or the bottom nail on the reference tag for non-tally references. When direct slope measurements are blocked by down logs or other objects, measure a horizontal distance. Write "HD" in remarks. Record sample point one reference information on the Reference Form.

Down Woody Material: See Remarks for recording instructions.

Cover Class: Measure the distance along the transect line for each cover type encountered. The sum of any one cover type can not exceed the length of the transect.

Hectare: Measure the distance of each live and dead tree tallied within 83 feet of sample point 1 to the face of each tree, at ground level, for live and dead trees tallied (determined to be "in" by limiting distance) within 83 feet of sample point 1

Sample point Number (2-digit)

Record the sample point number to distinguish it and associated information from other sample point records. Record the sample point number for each line entry.

Subplot Number (1-digit)

Record the appropriate subplot number for each line entry. Radius measurements are horizontal distance.

Code	Subplot size	Radius	English measure
1	1 hectare	185.1'	2.47 acres
2	.076 hectare	51.1'	1/5.3 acre
3	.02 hectare	26.3'	1/20 acre
4	.004 hectare	11.8'	1/100 acre
5	Transect length	51.1'	

Quadrant (1-digit)

Record for all individual trees tallied on subplots 2 through 4. To determine which quadrant a tree is in, measure from each sample point to the center of the tree bole.

Code	Quadrant
1	NE quadrant (360-89 degrees)
2	SE quadrant (90-179 degrees)
3	SW quadrant (180-269 degrees)
4	NW quadrant (270-359 degrees)

Vegetation Code (2-digit)

Record for all line items to identify the type of resource information being collected.

Code	Description
10	Live tree
11	Growth Sample Tree (GST)
13	Site Tree
15	Live Tree Group Tally
20	Dead tree
22	Stump
25	Dead Tree Group Tally
40	Indicator Species
60	Hardwood clump
70	Down woody material
80	Features
90	Cover Class
99	Non tally sample point reference (tree, stump or Object)

Listed below are the recording criteria for the individual vegetation codes.

Code 10 Live Tree

Conifer: Record all individual 1.0" dbh and larger not selected as a GST (Vegetation Code 11).

Hardwood: Record all individual 3.0" dbh and larger not selected as a GST. Record the first individual 1.0 - 2.9" dbh per species. Group tally remaining species in this diameter class (veg. code 15)

Code 11 **Growth Sample Tree (GST)**

Record the first live standing tree per specie per diameter group at each sample point starting at 360° and moving in a clockwise direction. GST candidates are identified under **Species** later in this manual. GST diameter groups are listed below:

DBH Group	Growth	Age ^{2/}	Height
1.0- 2.9	5 year height growth ^{1/}	No	Yes
3.0 - 7.9	Radial growth	Yes	Yes
8.0 - 12.9	Radial growth	Yes	Yes
13.0 - 17.9	Radial growth	Yes	Yes
18.0 - 22.9	Radial growth	Yes	Yes
23.0 - 27.9	Radial growth	Yes	Yes
28.0 - 31.9	Radial growth	Yes	Yes
32.0 - 47.9	Radial growth	Yes	Yes
Largest \geq 48.0	Radial growth	Yes	Yes

^{1/} Trees having completed at least 5 years height growth will have height growth measurements to the nearest 1/10 foot for trees less than 15 feet tall and to the nearest whole foot for trees 15 feet tall or taller. Trees with less than 5 years height growth will have no entry in growth field.

^{2/} If rot or voids prevent an accurate ring count for age refer to Breast Height Age section later in this manual

Out of Order GST: Record a tree found out of order, and meeting the criteria of a GST, after the procedures of an out of order tree. Write in remarks "Out of Order GST". Record required GST information for the out of order tree. Change the mistakenly recorded GST to reflect the appropriate Vegetation Code and remove any non required information.

Code 13 **Site Tree:**

A site tree is a normally formed tree between 3 and 31.9" dbh, at least 30 years old, with a dominant, codominant crown or open grown class representing the average canopy height for that sample point. In addition a site tree may have minor damage (non affecting height growth), no defect, no evidence of suppression, and no interior rot. Each site tree shall be representative of the plant association (series) at each sample point.

Record at least one site tree per sample point in descending order of choice meeting the aforementioned criteria. Site tree selection may also fulfill GST needs if it meets the criteria of a GST (use code 13 even when a site tree is doubling as a GST). Use the table in Appendix H as a default of preferred site tree species by series if more specific Forest information is not available. For sample points with no site tree records note circumstances in Present Condition/Past Disturbance.

- Code 15 **Live Tree Group Tally**
- Record, by species, the number of individual seedling and hardwoods indicated below as group tally.
- Seedlings:** Live conifer and hardwoods 6" tall to 0.9" dbh.
- Hardwoods:** Live hardwoods' 1.0"-2.9" dbh. not selected as veg. code 10
- Code 20 **Dead Tree**
- Record all dead conifers 3.0" dbh and larger and dead hardwoods 3.0" dbh and larger. Record all trees as individuals.
- Code 22 **Stump**
- Group tally by species for all stumps found with root disease. The a rule of thumb for evaluation stumps should have approximately 50% of their bark intact at ground line.
- Code 25 **Dead Tree Group Tally:**
- Record, by species, dead trees 1.0" - 2.9" dbh as group tally.
- Code 40 **Indicator Species**
- Record plant association indicator species (shrub and herb) and other pertinent ground cover (lichen & moss) as listed in appendix G for each forest. Record once per sample point for each species.
- Code 60 **Hardwood Clump**
- Record all live stems in a hardwood clump 4.5' tall or taller and less than 3.0" dbh. Do not tally dead clumps or dead stems within clumps.
- Code 70 **Down Woody Material**
- Record down woody material 3.0" id and larger as individual tally along the length of the transect. Record .2"-2.9" diameter material, at the point of planar intersection, as group tally along the last ten feet of the transect.
- Code 80 **Features**
- Not recorded for this survey
- Code 90 **Cover Class**
- Measure for each cover type encountered along the transect. Cover types are indicators of vegetation and soil surface conditions found along each transect line.
- Code 99 **Non-tally Sample Point Reference** (Tree, Stump or Object)
- Non-tally SPR are recorded to provide adequate sample point referencing.

Tree Number (3-digit)

Record for individual: Live Trees 1.0" dbh and larger; Dead Trees 3" dbh and larger and Hardwood Clumps. Tree number tags are discreet resource identifiers and provide a way of identifying and maintaining permanent individual records. Since each is unique it is important that no two numbers are the same on any given Sample Unit.

Previous tree numbers

Recorded for:

1. Re-measurement trees or stumps on re-establishment plots.
2. Hardwood clumps on re-establishment plots.

Current Tree Numbers

The tree numbers presently used during the current survey. Record the three right-most digits appearing on the round aluminum tree tag. Do not use any number tags ending in "000".

New Plots - For the initial installation of a Sample Unit. Record only Current Tree Numbers, since no previous tree records are available.

Re-establishment Plots - Where this is a subsequent survey of a previously installed Sample Unit record a Previous Tree Number and Current Tree Number. These tree numbers will commonly be the same. Make every effort to reuse existing tags and keep individual records consistent. The only time Previous and Current Tree Numbers will be different for re-measured trees or stumps are when:

1. A new number tag must be installed because the old tag is missing, unable to be found, unusable or ends in "000".
2. The previous installation crew made an error and the number actually on the tag is different than that recorded on the plot card.

In both cases, record the previously recorded tag number in Previous Tree Number and the actual tag number in Current Tree Number.

Installing Tree Number Tags

Install tree number tags for live tally trees' 1.0" dbh and larger, dead tally trees 3" dbh and larger and all hardwood clumps. Solidly affix tree number tags with an aluminum nail 3" above ground level. Place the tag on the side facing the center of the sample point so that the numbers face outwards (away from the bole). Chop away bark and rotten wood as required to allow the nail to penetrate into solid wood. Do not chop into cambium layer. For live trees, leave 1/2 to 3/4 of nail exposed. The nail head shall be lower than the nail tip. Pull the number tag to the nail head after nail installation. For dead trees pound the nail in flush to increase its durability. Do not excessively remove bark on disease susceptible species such as hemlock and the true firs.

Reconciliation (1-digit)

Used when reinstalling previous surveys. Refer to the section on re-measurement.

Species (6-digit)

Record tree species for appropriate vegetative line items. The GST list identifies the specific candidates mentioned in vegetation code (GST).

GST

Code	Pines	Code	Douglas-fir - Redwood
PIJE	Jeffrey pine	PSME	Douglas-fir
PICO	Lodgepole pine	SEGI	Giant Sequoia
PIPO	Ponderosa pine	SESE2	Coast redwood
PIMO	Western white pine		
PILA	Sugar pine		Cedar - Larch
PIAT	Knobcone pine		
PIFL	Limber pine	CHNO	Alaska-cedar
PIAL	Whitebark pine	CADE3	Incense-cedar
		CHLA	Port-Orford-cedar
	True firs	THPL	Western redcedar
		LAOC	Western larch
ABGR	Grand fir	LALY	Subalpine larch
ABPR	Noble fir		
ABAM	Pacific silver fir		Spruce - Hemlock
ABMAS	Shasta red fir		
ABLA2	Subalpine fir	PIBR	Brewer Spruce
ABCO	White fir	PIEN	Englemann spruce
ABMA	California red fir	PISI	Sitka spruce
		TSHE	Western hemlock
	Other	TSME	Mountain hemlock
CUBA	Cypress		
JUOC	Western juniper		
TABR	Pacific yew		

When Species for a Dead Standing Tree, Down Woody Material, Stump, or Object is not identifiable use the following codes:

Code	Description
TREEC	Unknown Conifer
TREED	Unknown Hardwood
TREE	Unknown specie
OBJECT	For veg. code 99 only

Designate the following hardwood species as Growth Sample Trees, Tree or shrub by addendum for the specific Forests being surveyed:

Code	Hardwoods	Code	Hardwoods
ACMA	Bigleaf maple	MAD13	Apple
ALRH	White alder	POTR	Quaking aspen
ALRU	Red alder	POTR2	Black cottonwood
ARME	Pacific madrone	PREM	Cherry
BEPAC	Western paper birch	QUCH	Canyon live oak
CACH	Golden chinkapin	QUGA	Oregon white oak
CONU	Dogwood	QUKE	California black oak
CRATA	Hawthorn (Crataegus)	SALIX	Willow
FROR	Oregon ash	UMCA	Oregon myrtle
LIDE3	Tanoak		

Shrub Species

The following species may occasionally attain tree size, but will not be tallied as trees on the fixed radius plots:

Code	Common Name	Scientific Name
ACCI	Vine maple	Acer circinatum
ACGL	Rocky mountain maple	Acer glabrum
ACGLD	Douglas maple	Acer glabrum douglasii
ALIN	Mountain Alder	Alnus Incana
ALSI	Sitka alder	Alnus sinuata
ALTE	Thinleaf alder	Alnus tenuifolia
AMELA	Serviceberry	Amelanchier spp.
ARCTO	Manzanita	Arctostaphylos spp.
BEOC	water birch	Betula occidentalis
CEANO	Ceanothus	Ceanothus spp
CEMO	Mountain mahogany	Cercocarpus spp.
CORYL	Hazel	Corylus spp.
GARRY	Silktassel tree	Garrya spp.
HODI	Ocean spray	Holdodiscus discolor
OSCE	Indian plum	Osmaronia cerasiformis
PHILA	Mockorange	Philadelphus spp.
PHYSO	Ninebark	Physocarpus spp.
PRVI	Chokecherry and Klamath plum	Prunus spp.
RHODO	Rhododendron	Rhododendron spp.
RHPU	Cascara buckthorn	Rhamnus purshiana
SAMBU	Elderberry	Sambucus spp.
SORBU	Mountain ash	Sorbus spp.
TOXIC	Poison oak	Toxicodendron spp.
VIBUR	Arrowood or moosewood	Viburnum spp.

Diameter (4-digit)

Take diameter measurements for, live and dead trees, non-tally references, and down woody material. Record all diameters to the last whole tenth of an inch. Diameter irregularities are discussed in appendix F.

Tree diameter: (dbh): Establish the dbh point on the up hill side of the tree. Measure along the tree bole from the ground line or prominent root collar 4.5 feet. Attach a dbh nail at this point. All measurements of dbh on live and dead vegetation will be done with a diameter tape.

No adjustment of dbh is necessary for the presence of an individual root or down material at the base of the tree. Kick slight litter accumulations aside before measuring. Record dbh as follows:

Group tally: Seedlings - 6" high to .9" dbh. record as 0001 and for hardwood trees 1" to 2.9" record as 0020.

Trees 1" - 2.9" dbh: For those trees tallied as individuals measure to the last whole 0.1 inch. Do not mark the level of diameter measurement with an aluminum nail.

Trees 3" dbh and larger: Mark the level of diameter measurement with an aluminum nail. Leave as much of the nail exposed provided it is solidly affixed to the tree. If no distinguishable uphill side exists place the nail toward the sample point. Measure dbh immediately above the nail and record to the last whole 0.1 inch.

All measurements of dbh will be actual diameters. Do not reconstruct diameter to account for missing bark or rotten wood. Record the actual diameter present with no adjustment for minor irregularities.

Measuring dbh at positions other than 4.5' along the bole are discussed in diameter irregularities, appendix F.

Stump diameter: Measure inside bark diameter to the last whole tenth of an inch for all stumps used as non-tally sample point references. Measure dbh at the top of the stump. Mark the point of diameter measurement by placing a nail in the geometric center of the top of the stump. Take the average of two measurements across the top of the stump (inside bark) at right angles to each other will determine stump diameter. Take the first measurement across the shortest axis for the stump and the second at a right angle to it. Both measurements should cross the geometric center of the stump.

Down Woody Material diameter: Measure the diameter, to the last whole tenth of an inch, of the piece at the point where its central longitudinal axis intersects the sample plane. Lay a ruler perpendicular to the piece, avoiding parallax, if the piece is circular in cross section. Use a diameter tape if parallax exists or the piece is non-circular. Do not adjust the point of measurement for irregularities.

Record actual diameter for wood slabs and other non circular pieces. Do not reconstruct diameter to account for voids. Do not mark the diameter at point of plane intersection with an aluminum nail. If desired, use a shallow ax cut or similar mark.

For pieces in each diameter size class, record the following:

Diameter

- | | |
|-----------------------|---|
| 0.2 to 0.9 inches - | Record 0005. |
| 1.0 to 2.9 inches - | Record 0020 |
| 3.0 inches a larger - | Record actual diameter of each piece
to the last whole 0.1 inch. |

Total Height/Length (3-digit)

Height

Record total heights, to the nearest whole foot, for live trees, dead trees, live hardwood clumps, Indicator species and cover type.

Individual Trees: Measure from ground level, on the uphill side of its base, to the terminal leader. Measure height upslope from the tree. Measure height for trees that lean greater than 15% at a point perpendicular to the lean. Choose a position that gives optimum visibility of the tip and base of the item being measured. Collect total height for:

1. First live tree per species, per GST diameter class, per sample point.
2. All standing dead trees (or portions) 3" dbh and larger which have broken or missing tops.
3. All Site trees (veg. code 13).

In remarks record slope distance in feet and azimuth in degrees from the position where the height was measured to the base of the tree (Ht.- 94' @ 126°).

Hardwood Clumps: Determine the average height for each hardwood clump.

Indicator Species: Record the average height for each species one foot tall or taller. Record "000" if the average height is less than one foot.

Cover Type: Record the average height of the vegetative cover type (shrub, herb/forb and grasses) one foot tall or taller. Record "000" if the average height is less than one foot.

Length

Down Woody Material: Measure length of each piece in question to the nearest foot increment for all down woody pieces which are 3.0" in diameter or larger at the point of planar intersection. Define the limits of each piece before measurement. Measure the length of each piece in question, from a 3" small end diameter, to points of abrupt physical change or discontinuity (breakage, advanced decomposition or branching). Appendix F has further discussion of DWM.

Growth (3-digit)

Measure either a 10 year radial growth or 5-year height growth for GSTs based on tree species and diameter. No measurement of height growth is made for conifers with, a dead top (see height growth), or less than 6 branch whorls. *Do not measure five year height growth for: hemlocks; cedars or hardwoods.*

Radial Growth: Record radial growth when stem diameter is 3" dbh or larger. Bore trees for radial increment within 4 inches of and below the dbh nail whenever possible. Extract all cores from normally formed wood and do not bore in seams, wounds or immediately adjacent to branches. When necessary, move around the tree at dbh level and bore unaltered wood close to the dbh nail. Always leave the extracted core at the base of the tree below the dbh nail. Do not bore trees less than 3.0 inches dbh.

Trees growing on steep slopes or those with sweep in the butt log often develop compression wood on the uphill side. Cores removed from compression wood commonly expands and separates making accurate measurement impossible. Avoid boring in compression wood, move around the tree and bore close to a point perpendicular to the dbh nail.

Record length of the previous 10 years radial growth to the nearest 1/20 inch. Do not include the current year's growth as part of the measurement. Begin at the end of the previous year's summer wood band (dark) and measure back 10 growth rings towards the tree center. Mark, in red pencil, the previous 10 year growth history. For trees 3" dbh or larger, but less than 10 years old, measure radial growth for the number of years available on the core. Record 12/20th as 012.

Height Growth: Measure 5 year height growth when stem diameter is less than 3" dbh. Measure height growth from the live branch whorl indicating the end of last year's growth to the sixth whorl. Don't count false whorls. Do not measure height growth if two years of top growth is dead (current and one year previous). When a dead top precludes a height growth record a "000" for height growth. Record the appropriate damage to reflect the dead top.

- a) Measure to the last tenth of a foot for trees less than 15' tall. Record a height growth of 5.1' as 051
- b) Measure to the last whole foot for tree 15' tall or taller. A height growth of 20' recorded as 200.

Breast Height Age

Record for all live coniferous trees' 3.0" dbh and larger tallied as Site Trees and GSTs. Determine Breast Height Age from the same growth boring used for radial growth whenever possible. Whenever a tree is bored for age, make a red mark on every tenth growth ring starting from the exterior. Place all extracted cores at the base of the tree, below the dbh nail.

Determine age counts from borings of normally formed wood, whenever possible. For pitch rings, overgrown limbs or other localized deformities encountered bore the tree again from another angle at the same level on the tree.

GST: If actual age cannot be determined due to interior rot record "000" for age, and make appropriate damage/severity entry. Tree too large to get a complete core sample use "**Determining age of a large tree**".

Site Tree: After boring a core if actual age cannot be determined, or growth indicates a previously suppressed condition (bands of closely spaced rings in respect to past and future rings) select another tree.

Determining age of a large tree: Age trees with a radius greater than the length of an increment borer in the following manner:

Extract the core and count the rings. Obtain a bark thickness measurement by chopping away a small area so not to alter dbh. Measure the diameter of the tree and divide by two, then subtract the bark thickness. This yields the radius of the woody part of the tree. Measure the length of the woody part of the extracted core and subtract it from the radius of the woody part of the tree. This determines how much longer the core would have to be to reach the center of the tree. Count the number of rings in the interior two inches of the core and extrapolate to the center. Add this to the number of rings on the core (example in appendix F).

Crown Ratio (2-digit)

Record crown ratio for all live trees' 1.0" dbh and larger to the nearest percent (1-99%) of total height. Record a fifty percent crown ratio as 50.

Crown ratio or percent live crown is the ratio between that portion of the bole supporting live green foliage and the total height of the tree, expressed as a percentage.

Visually redistribute uneven crowns to attain a full even crown distribution. Do this by visually transferring branches from the long side to the short side to create an even crown length. Recognize that some species (Ponderosa Pine) develop sparse crowns. Use judgment and do not abnormally pack crowns when adjusting for voids.

Crown Ratio =
$$\frac{\text{portion of bole supporting live green foliage}}{\text{total tree height}}$$

Crown Class (1-digit)

Record the appropriate code that describes the relative position of the tree crown with respect to competing vegetation surrounding the tree. Record brush cover, crown class, for sapling when overstory tree competition is absent. Brush cover crown class is subordinate to tree crown class should both occur:

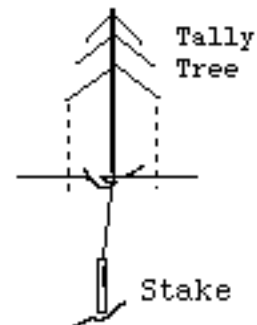
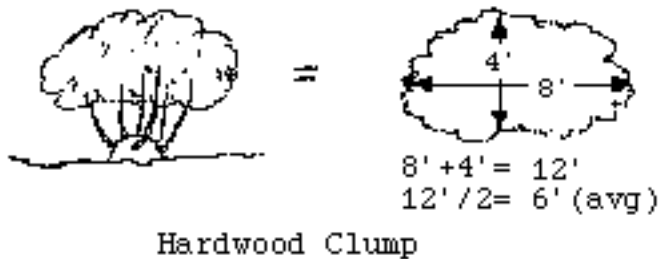
Code	Tree Crown Class	Code	Brush Cover Crown Class
1	Open Grown	7	Leader above brush
2	Dominant	8	Leader within brush
3	Codominant	9	Leader overtopped by brush
4	Intermediate		
5	Overtopped		
6	Remnant		

Crown Width (2-digit)

Record for all live hardwood clumps and Growth sample Trees. Measure width of live crown to the nearest 1 foot increment:

Hardwood clumps: Determine live crown width by averaging two measurements taken through the center of the clump. Take one measurement through the widest part of the crown and the other taken perpendicular to the first.

GSTs: Determine the live crown width by taking one measurement perpendicular to a line from the sample point stake to the tree center.



Damage/Severity (3-digit)

Use damage and the associated severity codes to describe the biotic and abiotic agents affecting sample unit trees. Record damage and severity for all live and dead trees (as indicated on the tally guide). When the specific damaging agent cannot be identified, use the general codes provided to identify the group of damaging agents.

Record damaging agents when they are present and associated severity. Line items with more than one damaging agent present record all Class I agents before Class II agents. Record damage as the first two digits and severity as the third digit.

Often trees are affected by more than one damaging agent. For example, there is a close relationship between agents such as root disease fungi and bark beetles, spruce budworm defoliation and Douglas-fir beetle, and logging damage and stem decay fungi. By recording multiple agents, the option to detect, identify and/or verify these relationships are preserved. Three damage fields are necessary to account for the variety of insects, diseases, and abiotic factors that affect tree growth, yield, composition and vegetative structure.

The list of damage codes is split into two groups: Class I and Class II agents. When multiple damaging agents occur on a tree, record all Class I agents before recording Class II agents.

Class I agents can seriously affect vegetation over the entire Region. Failure to account for these agents can result in large differences in predicted outcomes for tree growth, survival, vegetative composition and structure when compared observed situations. Class I agents are Root Diseases (Codes 60-66), Bark Beetles (Codes 01-09), Dwarf Mistletoes (Code 30), Defoliating Insects (Codes 10-19) and Dead/Broken/Missing Tops (Codes 96 and 97). Carefully examine trees for these agents. Record damaging agents when present.

Class II agents are those damage agents that can be important in local situations and recording their incidence and severity provides valuable information for stand, planning area, and sub regional analyses. Class II agents include the remainder of the list of damage codes. Record when present, but only after all Class I agents.

For detailed information and descriptions of damaging agents and their effects refer to Appendix E and the identification guides provided.

CLASS I AGENTS

BARK BEETLES:

CODE	DAMAGE	SEVERITY
01	General/other BB	1 - Unsuccessful current attack.
02	Mountain pine beetle (All Pinus spp)	
03	Douglas-fir beetle (PSME; LAOC)	2 - Successful current attack.
04	Spruce beetle (Picea spp; rare PICO)	3 - Last year's successful attack.
05	Western pine beetle (PIPO)	
06	Pine engraver beetle (All Pinus spp)	4 - Older dead.
07	Fir engraver beetle (Abies; TSHE; PIEN)	5 - Top kill.
08	Silver fir beetle (Abies; PSME; TSHE)	
09	Red turpentine beetle (All Pinus spp)	

Note: Bark beetles often attack trees weakened by root disease fungi or other agents. Carefully examine trees indicating bark beetle attack for evidence of root disease.

DEFOLIATORS:

CODE	DAMAGE	SEVERITY
10	General/other	1-9 Divide live crown into thirds. Rate each third separately based on the following cutoffs: 0 - No detectable defoliation 1 - up to 33% foliage (old and new) missing 2 - 34-66% missing foliage 3 - 67-100% missing foliage Obtain rating for entire tree by adding ratings for each third. Record total in severity column.
11	Western blackheaded Budworm	
12	Pine butterfly	
13	Douglas fir tussock moth	
14	Larch casebearer	
15	Western spruce/Modoc Budworm	
16	Western hemlock looper	
17	Sawflies	
18	Needle and sheath miners	
19	Gypsy moth	

DWARF MISTLETOE:

CODE	DAMAGE	SEVERITY
30	Dwarf mistletoe	1-6 Divide the live crown into thirds. Rate each third separately and give each third a rating based on the following cutoffs: 0 = No visible infections. 1 = 1/2 or less of total number of branches have visible infections. 2 = More than 1/2 the branches have visible infections. Obtain rating for entire tree by adding ratings for each third. For dead trees with evidence of dwarf mistletoe such as brooms on the tree or ground, estimate rating at time of death and record

ROOT DISEASE:

Record for all trees and stumps.

CODE	DAMAGE	SEVERITY
60	General/other root disease	1 - Live tree within 30' of a tree or stump with known root disease OR dead tree where root disease has NOT been identified within 30' of a tree or stump with known root disease.
61	Annosus root disease	
62	Armillaria root disease	
63	Black stain root disease	
65	Laminated root rot	
66	Port-Orford-cedar root disease	2 - Live tree with signs or symptoms diagnostic for root disease such as characteristic decay, stain, ectotrophic mycelia, mycelial fans, conks or excessive resin flow at the root collar. No visible crown deterioration. 3 - Live tree with signs or symptoms diagnostic for root disease such as characteristic decay, stain, ectotrophic mycelia, mycelial fans, conks or excessive resin flow at the root collar. Visible crown deterioration such as thinning, chlorotic foliage, reduced terminal growth and/or stress cones. OR dead tree with signs or symptoms diagnostic for root disease.

BROKEN/MISSING/DEAD TOPS:

CODE	DAMAGE	SEVERITY	%
96	Broken/Missing top	0	01-10
97	Dead top	1	11-20
		2	21-30
		3	31-40
		4	41-50
		5	51-60
		6	61-70
		7	71-80
		8	81-90
		9	91-100

CLASS II AGENTS**OTHER INSECTS:**

CODE	DAMAGE	SEVERITY
20	General	1 - Bottlebrush or shortened leaders
21	Shoot moths	0-2 forks on tree stem OR less
22	Weevils	than 20% of branches affected OR
23	Wood borers	less than 50% of bole with
24	Balsam wooly Adelgid	visible larval galleries.
		2 - 3+ forks on tree stem OR 20% or
		more of branches affected OR
		terminal leader dead OR
		>= 50% of bole with visible larval
		galleries.

WHITE PINE BLISTER RUST:

CODE	DAMAGE	SEVERITY
36	White pine blister rust	1 - Branch infections located
		greater than 2' from tree bole.
		2 - Branch infections located
		between 6" and 2' from bole.
		3 - Bole infections or branch
		infections within 6" of bole.

STEM-BRANCH CANKERS:

CODE	DAMAGE	SEVERITY
40	General/other	1 - Branch infections. Less than 50% of the crown involved.
41	Western gall rust (PIPO, PICO)	
42	Comandra blister rust (PIPO)	
43	Stalactiform rust (PICO)	2 - Branch infections. 50% or more of crown involved. Any occurrence on the bole.
44	Atropellis canker (Pinus spp)	
45	Cytospora/Phomopsis (PSME, Abies)	

STEM DECAYS:

CODE	DAMAGE	SEVERITY
46	General/other	1 - 1 conk on stem or at ground line .
47	Red ring rot (P. pini)	
48	Indian paint (E. tinctorium)	2 - 2 or more conks separated by less than 16' on the bole.
49	Brown cubical (P. schweinitzii)	3 - 2 or more conks separated by 16' or more on the bole.
		4 - No conks. Visible decay in interior of bole

FOLIAR PATHOGENS:

CODE	DAMAGE	SEVERITY
55	General/other	1 - Less than 20% of foliage affected or less than 20% of crown in brooms.
56	Rhabdocline (Only PSME)	
57	Elytroderma (Only PIPO)	
58	Broom rusts (Only Abies, Picea)	2 - 20% or more of foliage affected or 20% or more of crown in brooms.

DAMAGES: ANIMAL, WEATHER, OTHER:

CODE	DAMAGE	SEVERITY
70	Animal-General/ unknown	1 - Less than 20% of crown affected.
71	Mountain beaver	Bole damage restricted to less than 1/2 of circumference.
72	Livestock	
73	Deer or Elk	2 - 20% or more of crown affected.
74	Porcupines	Bole damage to 1/2 or more of the circumference.
75	Pocket gophers, squirrels, mice, voles, rabbits, hares	
76	Beaver	
77	Bear	
78	Human (not logging)	
80	Weather-General/ unknown	1 - Less than 20% of crown affected.
81	Windthrow or wind breakage	2 - 20% or more of crown affected or any damage to bole.
82	Snow/ice bending or breakage	
83	Frost damage on shoots	
84	Winter desiccation	
85	Drought/heat moisture deficiency	
86	Sun scald	
87	Lightning damage	
90	Other/unknown damage	1 - Less than 20% of crown affected.
91	Logging damage	2 - 20% or more of crown affected or any damage to bole.
92	Fire: basal scars or heat	
93	Improper planting technique	
94	Air pollution or other chemical damage	

PHYSICAL DAMAGE:

CODE	DAMAGE	SEVERITY
95	Unspecified physical defect	
98	Forks/lean/crooks/sweep	Severity Code = 0
99	Checks/bole cracks	

Defect Deduction (1-digit)

Record a defect deduction only if a damage/severity has been recorded. Determine for all trees 5" dbh and larger tallied on all subplots with vegetation code 10, 11 or 20. Determine defect deductions to the nearest ten percent of total tree volume. Code defect deduction 0-9: **0**=no defect, **1**=1 to 10%, **2**=11 to 20%, **3**=21 to 30%, **4**=31 to 40%, **5**=41 to 50%, **6**=51 to 60%, **7**=61 to 70%, **8**=71 to 80%, **9**=81 to 100% defect.

Defect deduction represents the percentage loss of sound wood fiber from the overall biomass of a tree. Base defect deduction on losses due to visible indicators from voids, decay, and deformity. Evaluate defect between stump height and the minimum top diameter.

For Tree 5" dbh and larger use the following specifications:

Size Class	Stump Height Inches	Segment length (Feet)	Minimum top diameter outside bark (Inches)
(9.0"+)	12	16	6
(5.0"-8.9")	12	8	4

To determine the appropriate amount of biomass loss, locate and identify each defect indicator by segment position and determine its appropriate deduction as a percentage of segment biomass. For example, 8 feet in the third segment of a tree is found to have decay. This equals 50 percent of the volume within that segment ($8/16 = .50$).

The following is a list of the defect indicators, by class, that field crews can use to evaluate defect deductions.

Void	Decay		Deformity
1. Missing bole Portions	1. Conks	4. Rotten Scars	1. Bole Swelling
	2. Dead Tops 3. Top Rot	5. Sapwood Rot 6. Interior Rot	2. Shattered Ends

Condition/Use (2-digit)

Record for all dead trees' 3.0" dbh and larger tallied on all subplots and Down Woody Material 3.0" id and larger tallied along the line transect. The application varies by Vegetation Code and physical characteristics. The first digit of each code (left-most) describes the physical characteristics of the tree while the second digit indicates the presence or absence of wildlife use.

Dead Trees

Record only the standing portions of dead trees 3.0" dbh and larger. The upright portion must be at least 4.5 feet tall or taller to be considered standing dead.

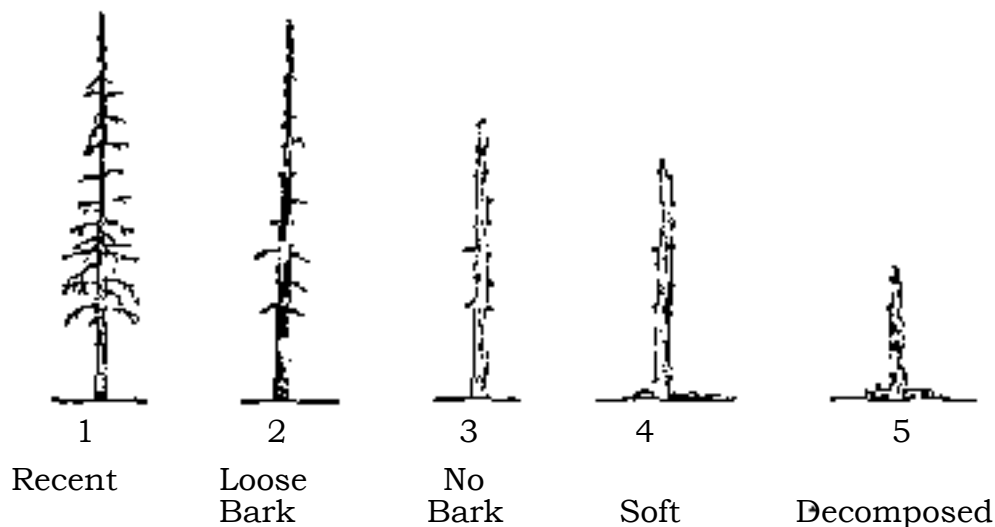
Condition codes provide descriptions of general physical conditions. Use the following descriptions and diagrams as an aid for determining the appropriate condition code of the dead tree or tree portion.

Use code's 1_ through 5_ to describe: Dead trees (and standing portions thereof) which are taller than 4.5' and which have the following general characteristics:

	Bark	Heartwood Decay	Sapwood Decay	Limbs	Top Breakage	Bole Form
Code 1_ Recent (1-5 yrs.)	Tight Intact	None to Minor	None to Incipient	Mostly present	May be Present	Intact
Code 2_ Loose Bark	50% loose or Missing	none to Advanced	None to Incipient	Small Limbs Missing	May be present	Intact
Code 3_ Clean	75%+ Missing	Incipient to Advanced	None to 25%	Few remaining	Usually 1/3	Mostly Intact
Code 4_ Soft	75% Missing	Incipient to Advanced	25%+	Few remaining	Usually 1/3-1/2	Starting to lose form
Code 5_ Decomposed	75% Missing	Advanced to Crumbly	50%+ Advanced	Absent	Usually 1/2+	Form mostly lost

Recent mortality is represented by code 1.

Standing Dead Trees and Tree Portions



Use codes provide an indication of wildlife use based on the presence or absence of excavations' 1.0" in diameter or larger. This includes only excavations made by wildlife (denning, resting, feeding, etc.). Use the following codes as the second digit to record the presence or absence of wildlife use:

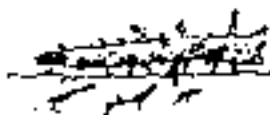
Code	Use
0	No excavations' 1.0" in diameter or larger.
1	One or more excavation's 1.0" in diameter or larger present.

Down Woody Material

Recorded for all down woody pieces that are 3.0" id or larger along the transect. The first digit of each code (left-most) describes physical characteristics of the piece while the second digit indicates the presence or absence of wildlife use.

Assign **Condition codes** based on the characteristics of the piece observed at the point of plane intersection. Record the following codes as the first digit based on these general characteristics:

	Bark	Limbs	Texture	shape	Color of Wood	Portion on Ground
Code 1_ Recent	Intact	Present	Mostly Sound	Round	Original Color	Elevated on support points
Code 2_ Inter-mediate	Loose or Missing	Mostly Present	Sapwood Decay Present	Round	Original to Faded	All to Mostly Sagging
Code 3_ Decomposed	Usually Absent	Branch Stubs Loose	Interior Decay Present	Round to Oval	Faded	All of piece on Ground



1_

Recent



2_

Intermediate



3_

Decomposed

Use codes provide an indication of wildlife use based on the presence or absence of excavations 1.0 inch in diameter or larger. This includes only excavations made by wildlife (denning, resting, feeding, etc.). Examine the entire length of the piece and record one of the following use codes as the second digit:

Code	Use
_ 0	No excavations' 1.0" in diameter or larger.
_ 1	One or more excavation's 1.0" in diameter or larger present.

Large End Diameter (2-digit)

Record for all 3.0" id and larger down woody material (veg. code 70) encountered along the line transect. Record to the nearest inch. For down trees record large end diameter at stump height.

Group tally (3-digit)

1. Down Woody Pieces: Tally 0.2 to 2.9 inch intersect diameters on the last 10 feet of each line transect. Group these pieces into two diameter categories: Category 0005 represents pieces' 0.2 to 0.9 inches; Category 0020 represents pieces' 1.0 to 2.9 inches. Record each category as a single line entry and denotes the number of pieces tallied. Record 1 piece as 001, 17 pieces as 017, etc. Use code 099 to record 99 pieces or more.

Complete each line entry for veg. code 70 whether or not tally exists. Record the following information when no tally exists, for a specific diameter group, on a transect: sample point #, Subplot #, Vegetation Code, Diameter (0030, 0020, or 0005), and Group Tally ('000').

2. Seedlings: Group live seedlings' by species on the .004 hectare. Record each species group as a single line entry denoting the number of seedlings represented up to 999.

3. Hardwoods 1.0 - 2.9" dbh: Group tally individual stems by species not recorded as individual live trees on the .004 hectare.

4. Hardwood clumps: Record the number of live stems less than 3.0" dbh within each hardwood clump, up to 999.

5. Hardwoods 3-12.9" dbh: Record the hardwood clump number for each individual hardwood tree that originated as a stem (less than 3" dbh) within that hardwood clump.

6. Stumps 5" and larger: tallied on appropriate subplots when they have indicators of root rot.

7. Dead Trees 1.0 - 2.9" on the .004 hectare are group tallied by species.

Cover Type (2-digit)

Record each cover type as a single line item after the Down Woody Material transect is complete. More than one cover type may exist along the sample plane above a point on the line transect.

10	Bare Soil	30	Organic Material
12	Water	32	Debris
14	Rocky	36	Herb/Forb/Grass
17	Rock Fragments	38	Shrub
18	Roads	40	Moss/Lichen

Percent Cover (2-digit)

Record the nearest whole percent (%) cover estimations for indicator species identified by the forest and found on the .02 hectare. For species with less than 1% cover use zero (00) to indicate a trace amount.

Remarks

Additional information used to highlight specific items, clarify measurement irregularities, and assist inspections.

Distance: For *Down Woody Material* record the slope distance to the nearest foot. Measure from the beginning of the transect to the point of planar intersection for each piece of down woody material 3" diameter and larger along the transect line; For *trees receiving heights* record slope distance from the position the height is being taken to the base of the tree.

Azimuth: For trees receiving heights record the azimuth in degrees from the position the height is being taken to the base of the tree.

Out of Order GST: Record this statement when the out of order tree would affect a previous GST selection.

Out Of Order: Excluding "Out Of Order GST", record this statement for all trees 1" dbh or larger and hardwood clumps not tallied in sequential order starting at 360°.

Estimated: Record when tree age is not a direct measurement.

REF: Record this statement for all sample point references.

Record other deviations to manual procedures in remarks.

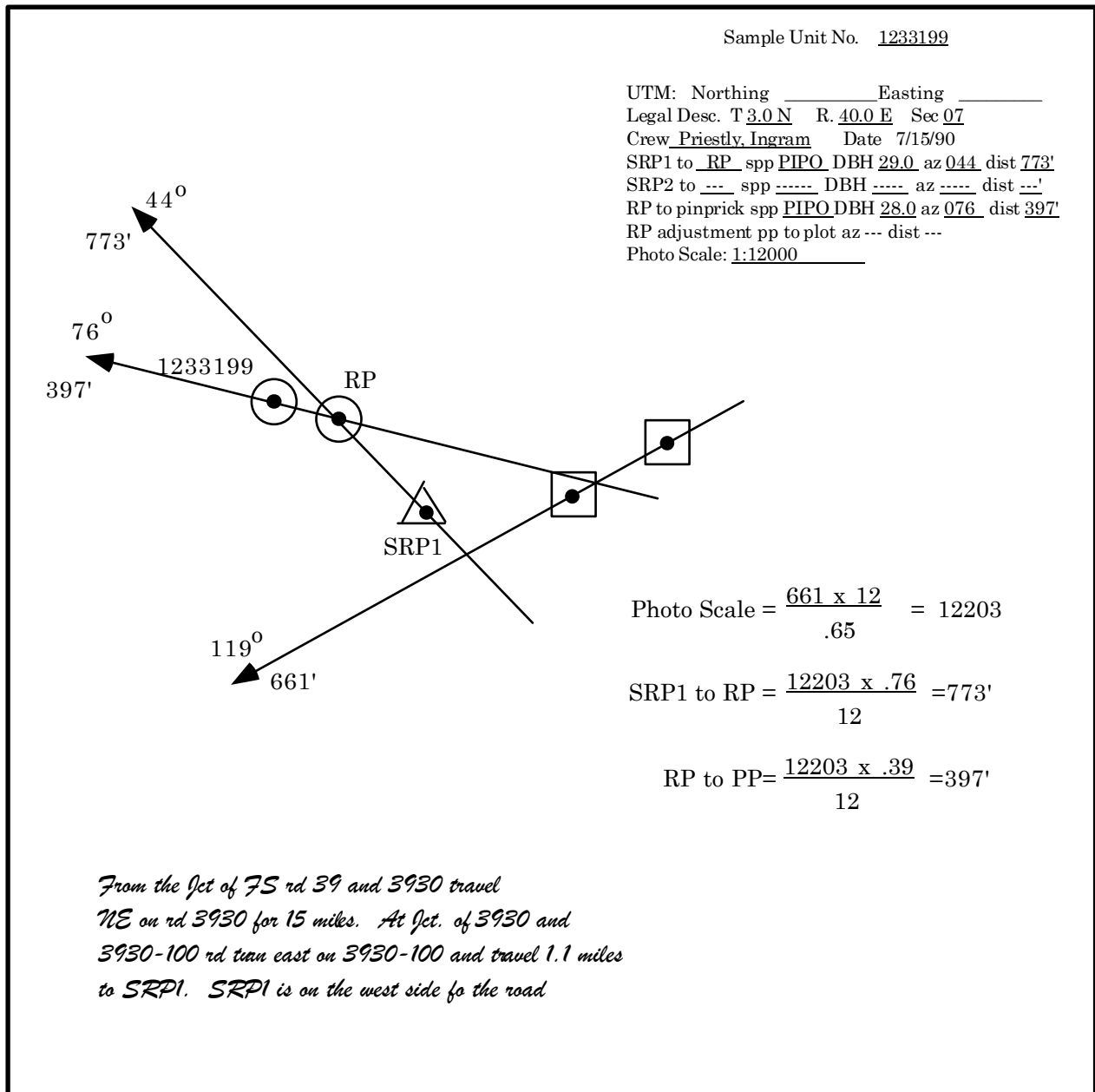
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Vegetation Data Form Tally Guide

Appendix B

Photo Calculation



Backside of Primary Aerial Photo

Appendix C

Glossary

Use the following definitions and classifications during the establishment of survey plots in Region 6.

Breast Height (bh)	On standing trees a measurement along the bole, on the uphill side, 4.5' from ground level or above a predominant root collar .
Codominant Tree	One of many trees having its crown in the upper layer of the canopy but in a subordinate position in relation to the dominant trees. The crown receives full sunlight from above but comparatively little from the side
Cover Type	Uniquely identified variable that is identified along the length of a transect line.
Dead Tree	A dead tree is one which does not have any green foliage or healthy meristematic tissue.
Debris	Down Woody Material (see DWM definition) .2" intersect diameter or larger.
Diameter Breast Height (dbh)	A measurement taken at breast height, outside bark and perpendicular to the tree bole.
Dominant Tree	One of many trees having its crown in the uppermost layer of the canopy and is free growing. The crown receives full sunlight from above and partly from the side.
Down Woody Material	<p>Down woody material consists of dead tree boles, limbs and other woody pieces that have been severed from their original source of growth and have fallen to the ground. This includes uprooted tree boles and any stems or branches attached to them. It does not include:</p> <ol style="list-style-type: none">1.Standing trees, stumps, or shrubs.2.Dead stems or branches <u>attached</u> to standing trees, stumps, or shrubs.3.Dead foliage, bark or other non-woody pieces which are not an integral part of a bole or limb (i.e., bark attached to a portion of down log would be tallied as part of that log).

Group Tally	Recording as a single line entry one or more items of the same species. No tree numbers are assigned.
Hardwood Clumps	Two or more live stems, 4.5 feet or taller and less than 3" dbh, arising from a common root collar or parent stump.
Improved Road	These roads usually have one or all of the following characteristics; 1) map and sign number designations, 2) surfacing, 3) ditching and culverts, and 4) periodic maintenance. For the purposes of point establishment the "edge" of the road will be considered to be the edge of the clearing limit where a right-of-way is maintained.
Intermediate Tree	One of many trees having its crown in the middle layer of the canopy with only the leading shoot free. The crown occupies a subordinate position and is subject to strong lateral competition from dominants and codominants.
Intersect diameter (id)	Measurement of diameter at a point where the sampling plane of a line transect intersects with an object being tallied.
Leader Above Brush	Terminal leader of tree is above the surrounding brush. Middle and lower crown may be within the brush canopy
Leader Overtopped	Crown completely overtopped by the surrounding brush.
Leader Within Brush	Terminal leader and upper crown are within brush canopy.
Live Trees	A tree is considered live if, at the time of sampling, it has any amount of green foliage and root contact with the soil. Since green foliage may be missing from deciduous trees at the time of sampling, the condition of the meristematic tissue (buds and cambium) should be evaluated instead.
Normally Formed Tree	A normally formed tree is one whose central bole exhibits physiological traits and development typical of that tree species, age and local environment. Normally formed tree have been in a Dominant or Codominant crown class it entire life.
Open Grown Tree	Crown which receives full sunlight from above and on all sides
Organic Material	Vegetative material less than .2" intersect diameter that has separated from its original source of growth and forms a continuous mat on eastside forests or a continuous mat with a depth of 2" or greater on westside. forests. Debris will be classified as organic material when over 50% is incorporated within the organic layer.

Overtopped Tree	Crowns receive no direct sunlight from above or from the sides and are entirely below the general canopy level in even-aged stands
Parallax	The apparent change in the position of an object resulting from the change in the direction or position from which it is viewed.
Remnant Tree	A tree left by previous management activity or catastrophic event that is significantly older than the surrounding vegetation. Remnant trees do not form a canopy layer and are usually isolated individuals or small clumps.
Rock	Particles of rock larger than 3/4 inch in diameter appearing on the soil surface (FSH 2209.14, 2.34/6d).
Rock Fragments	Particles of rock from 1/8 to 3/4 inch in diameter covering 50% or more of the soil surface in a more or less continuous layer (FSH 2209.14, 2.34/6e).
Sample Plane	An imaginary line vertical to the ground and passing through the line transect. For Down Woody Material the sample plane extends from the ground surface to six feet above the ground. For Cover Class the sample plane has no top boundary.
Sapling	A young tree ranging in dbh from 1.0" dbh to a time when its lower branches begin to die (3.0"-5.0" dbh).
Seedlings	<p>A seedling is a tree that is: 1) at least 6 inches in height; 2) has a dbh of less than 1.0 inches and; 3) has its root system in contact with mineral soil.</p> <p>The branches of some coniferous tree species occasionally become rooted when in contact with the ground. These are not considered seedlings. Limbs that are upturned on stumps and attempting to express their dominance are not tallied as seedlings.</p>
Standing Tree	A standing tree is one that is in a self-supporting, upright position and which has root contact with the soil.
Stump	A stump is the basal portion of a tree remaining in contact with the soil after the trunk or stem has been cut or broken off less than or equal to 4.5' in height, and is greater than 5" diameter (cross sectional).
Stump Height	One foot from the ground line on the upslope side.
Suppressed Tree	One of many trees having its crown in the lower layer of the canopy, the leading shoot is not free. The crown receives no direct sunlight.

Tally	The recording of an individual line entry of data.
Total Height	The vertical distance between the base of a tree and the top of the live terminal leader.
Unimproved Road	Roads not meeting the standards for improved roads will be considered unimproved and will be classified according to the surrounding area. Examples of unimproved roads are logging spurs into sale units and roads classified as primitive on Form 7700-9R.
Water	A situation where the occurrence of the water table is at or above the ground surface during the growing season (Stream channel, bog, swamp, marsh).

Appendix D

Traverse Slope Adjustment

(Use for adjustment along a traverse)

Slope (%)	Expansion Factor	Expansion Factor Reciprocal	Slope (%)	Expansion Factor	Expansion Factor Reciprocal
5	1.000		44	1.093	.914
6	1.001		45	1.097	.910
7	1.002		46	1.101	.906
8	1.003		47	1.105	.902
9	1.004		48	1.110	.898
10	1.005	1.000	49	1.114	.894
11	1.006	.998	50	1.118	.890
12	1.007	.996	51	1.123	.888
13	1.008	.994	52	1.127	.886
14	1.009	.992	53	1.132	.884
15	1.010	.990	54	1.136	.882
16	1.012	.988	55	1.141	.880
17	1.014	.986	56	1.146	.876
18	1.016	.984	57	1.151	.872
19	1.018	.982	58	1.156	.868
20	1.020	.980	59	1.161	.864
21	1.022	.978	60	1.166	.860
22	1.024	.976	61	1.172	.856
23	1.026	.974	62	1.177	.852
24	1.028	.972	63	1.183	.848
25	1.031	.970	64	1.188	.844
26	1.034	.968	65	1.194	.840
27	1.036	.966	66	1.199	.836
28	1.039	.964	67	1.205	.832
29	1.041	.962	68	1.210	.828
30	1.044	.960	69	1.216	.824
31	1.047	.956	70	1.221	.820
32	1.050	.952	71	1.227	.816
33	1.054	.946	72	1.233	.812
34	1.057	.944	73	1.238	.808
35	1.060	.940	74	1.244	.804
36	1.063	.938	75	1.250	.800
37	1.067	.936	76	1.256	.796
38	1.070	.934	77	1.262	.792
39	1.074	.932	78	1.269	.788
40	1.077	.930	79	1.275	.784
41	1.081	.926	80	1.281	.780
42	1.085	.922	81	1.287	.776
43	1.089	.918	82	1.293	.772

Traverse Slope Adjustment (cont.)					
Slope	Expansion Factor	Expansion Factor Reciprocal	Slope	Expansion Factor	Expansion Factor Reciprocal
83	1.300	.768	117	1.539	.652
84	1.306	.764	118	1.547	.648
85	1.312	.760	119	1.554	.644
86	1.319	.756	120	1.562	.640
87	1.325	.752	121	1.567	.636
88	1.332	.748	122	1.578	.632
89	1.338	.744	123	1.585	.628
90	1.345	.740	124	1.593	.624
91	1.352	.736	125	1.601	.620
92	1.359	.732	126	1.609	.618
93	1.365	.728	127	1.617	.616
94	1.372	.724	128	1.624	.614
95	1.379	.720	129	1.621	.612
96	1.386	.716	130	1.640	.610
97	1.393	.712	131	1.648	.608
98	1.400	.708	132	1.656	.606
99	1.407	.704	133	1.664	.604
100	1.414	.700	134	1.672	.602
101	1.421	.698	135	1.680	.600
102	1.428	.696	136	1.688	.596
103	1.436	.694	137	1.696	.592
104	1.443	.692	138	1.704	.588
105	1.450	.690	139	1.712	.584
106	1.457	.686	140	1.720	.580
107	1.464	.682	141	1.728	.578
108	1.472	.678	142	1.736	.576
109	1.479	.674	143	1.745	.574
110	1.486	.670	144	1.753	.572
111	1.494	.688	145	1.761	.570
112	1.501	.666	146	1.769	.566
113	1.509	.664	147	1.778	.562
114	1.516	.662	148	1.786	.558
115	1.524	.660	149	1.795	.554
116	1.532	.656	150	1.803	.550

DISTANCE CORRECTION

- Adjusted Slope Distance = Slope distance x % slope exp. factor
- Horizontal Distance = Slope distance x exp. factor reciprocal
- Horizontal Distance = Slope distance x Cos. of vertical angle

TREE HEIGHT CALCULATION

- Total Height = Horizontal distance x (upper % \pm Lower %)
- Total Height = Tan $_1 \pm$ Tan $_2$ x horizontal distance

Percent Distribution of Total Stem Volume By 8 - Foot Segments
(to minimum top diameter)

Segment Number

Tree Ht.	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
0.5	100																			
1		100																		
1.5		80	20																	
2		55		45																
2.5		49		38	13															
3		41		33		26														
3.5		38		30		23	9													
4		33		28		22		17												
4.5		32		26		20		16	6											
5		28		24		20		16		12										
5.5		27		22		19		16		12	4									
6		25		22		18		15		12		8								
6.5		23		21		17		15		12		9	3							
7		22		20		17		14		12		9		6						
7.5		21		19		16		14		11		9		7	3					
8		20		18		16		14		11		9		7		5				
8.5		19		18		15		13		11		9		7		6	2			
9		18		17		15		13		11		9		7		6		4		
9.5		18		16		15		13		11		9		7		6		4	1	
10		17		16		14		12		10		9		8		6		5		3

Percent Distribution of Total Stem Volume By 16 Foot Segment
(to minimum top diameter)

Segment Number

Tree Ht.	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12
0.5	100																							
1		100																						
1.5		83	17																					
2		70		30																				
2.5		64		30	6																			
3		55		35		10																		
3.5		47		34		16	3																	
4		41		31		20		8																
4.5		37		29		20		12	2															
5		32		27		21		14		6														
5.5		30		25		19		15		9	2													
6		27		23		19		15		11		5												
6.5		26		21		17		15		12		7	2											
7		23		20		17		15		12		8		5										
7.5		21		19		17		15		12		9		5	2									
8		20		18		16		14		12		9		7		4								
8.5		19		16		16		14		11		10		7		5	2							
9		17		16		15		13		11		10		8		6		4						
9.5		17		16		15		12		12		10		8		6		5	1					
10		16		15		13		12		11		10		8		7		5		3				
10.5		15		14		13		12		11		10		8		7		5		4	1			
11		14		13		13		11		11		10		8		7		6		4		3		
11.5		14		13		12		11		11		10		8		7		6		4		3	1	
12		14		13		12		11		10		10		8		7		5		4		3		2

Appendix E

Guide To Identification of Damaging Agents

GUIDES FOR IDENTIFICATION OF BARK BEETLES

(Codes 0 1 * - 0 9 *)

General Description

Most bark beetles that concern forest managers in the Pacific Northwest Region attack weakened, stressed, or overmature trees. Adults attack trees in large numbers, boring into trees to create tunnels (egg galleries) and laying eggs on the inner surface of the bark along the bole. External signs of attack include pitch tubes and/or boring dust, depending on the tree species. Larvae usually construct separate tunnels away from the egg gallery in patterns that are characteristic for each species. Sometimes adult beetles introduce fungi into egg galleries. Egg galleries, larval mines, and the introduced fungi disrupt the carbohydrate and water transport systems within a tree and can cause death.

Adult bark beetles are generally 1/4-3/8 inches (6-10 mm) long. Major genera can be distinguished by the shape and coloration of their abdomens. Larvae are creamy-white, legless, and have brown head capsules. Pupae, usually found at the ends of the larval mines, are shiny white. Adults are initially pale yellow or tan, darken to reddish-brown, and turn black or very dark red-brown at maturity.

MOUNTAIN PINE BEETLE (*Dendroctonus ponderosae*) Code 0 2 *

Hosts: Lodgepole, ponderosa, sugar, western white, and whitebark pines. Other pines have been recorded as hosts but are rarely attacked.

Evidence of Infestation: Pitch tubes are 1/4-1/2 inches (6-13 mm) in diameter, faint pink to dark red in color, and appear during the summer months. Large white pitch tubes, 3/4-1 inch (19-25 mm) in diameter, that are widely scattered over the trunk are signs of an unsuccessful beetle attack. Reddish boring dust sometimes appears in bark crevices and around the base of an attacked tree. Blue-stain fungi may stain wood 1-2 months after beetle attack. Needles on successfully attacked trees start to fade several months to almost 1 year after attack. The sequence of color changes is green to yellowish-green, then sorrel (1 year after attack), red to rusty-brown (2 years old) and devoid of needles (3 or more years old). Fading usually begins from the bottom of the crown and proceeds upward. Mountain pine beetle does not cause topkill (severity code 5)

Egg galleries are 12-36 inches (30-90 cm) long and generally run vertically. Often these galleries have a short bend or hook at the lower end, giving them a J-shaped appearance. Larval galleries extend horizontally away from the egg galleries. Both egg and larval galleries are mostly constructed in the inner bark, and the sapwood is only lightly scored. Generally there is one generation per year.

DOUGLAS-FIR BEETLE (*Dendroctonus psuedotsugae*) Code 0 3 *

Hosts: Douglas-fir and infrequently western larch; prefers windthrown or weakened trees, large pieces of slash, and fresh stumps.

Evidence of Infestation: Reddish-orange boring dust can be found in bark crevices and around the bases of infested trees (May-June). No pitch tubes are produced. Wind and rain remove boring dust, and these beetles may attack portions of the upper bole only, so trees must be examined carefully to detect the presence of beetles. Resin exuding from entrance holes at the upper limit of infestation is sometimes the last evidence of attack. Needles turn yellow, then sorrel, and finally reddish brown 1 year after attack. Needles are shed and conks of the pouch fungus *Cryptoporus volvatus* form on the outer bark during the year following infestation. Unsuccessful current attacks (severity code 1) are not readily observed. Douglas-fir beetle does not cause topkill (severity code 5).

Egg galleries are straight or slightly wavy, vertical, and range from 5-35 inches (12-90 cm) long with an average length of 12 inches (30 cm). Eggs are laid in batches on alternating sides of the egg galleries; the larval galleries fan out horizontally, away from the egg gallery. The sapwood is only lightly scored by galleries. There is one generation per year.

SPRUCE BEETLE (*Dendroctonus rufipennis*) Code 0 4 *

Hosts: Engelmann, sitka, and white spruce; prefers windthrown or weakened trees, large pieces of slash, and fresh stumps.

Evidence of Infestation: Red boring dust accumulates in bark crevices around the bases of infested trees. Pitch tubes are not formed, though occasionally resin may stream from entrance holes; often these resin streams indicate unsuccessful attack. Needles of infested trees turn yellowish-green and fall 1 year after attack. Needles do not turn reddish color as do beetle-infested pines. Recently killed trees appear yellowish-orange to red after needle drop due to color of exposed twigs. This change in hue is especially visible in the upper third of the crown. Woodpeckers often search through the bark during winter months when larvae are large. Unsuccessful current attacks (severity code 1) cannot be observed. Spruce beetle does not cause topkill (severity code 5).

Egg galleries are vertical and 2-7 inches (6-22 cm) in length. Eggs are laid in batches along alternating sides of the galleries. Larval mines radiate away from the egg galleries at first, but later may meander and cross each other. From 1-3 years may be required per generation, depending on latitude and elevation, with most populations requiring 2 years.

WESTERN PINE BEETLE (*Dendroctonus brevicomis*) Code 0 5 *

Hosts: Ponderosa and coulter pine.

Evidence of Infestation: Small, inconspicuous reddish pitch tubes that are 1/4-1/2 inches (6-13 mm) wide or red boring dust are the earliest signs of infestation. White to yellow pitch tubes are evidence of an unsuccessful current attack. As the attack progresses, needles gradually fade to lemon yellow, then to straw color, sorrel, and red. During winter months, woodpeckers may chip away at the bark in search of beetles. Western pine beetle does not cause topkill (severity code 5).

Egg galleries are winding or spaghetti-like, crisscrossing under the bark. Newly hatched larvae feed in the inner bark, but soon turn into the outer bark to complete their life cycle, so that only about 1/2 inch (13 mm) of a larval gallery is visible on the inner bark/sapwood surface. Usually there are two generations per year, though this may vary from 1-3 depending on latitude and elevation.

PINE ENGRAVER (*Ips pini*) Code 0 6 *

Hosts: Ponderosa, lodgepole, limber, and Jeffrey pines. Occasional hosts include other pines and spruce. Populations commonly infest slash, windthrow, the tops of live trees, or whole live trees.

Evidence of Infestation: The first indication of attack on down material is reddish-orange dust in small mounds at beetle entrance holes. In standing trees, infestation progresses from top downward. Boring dust lodges in bark crevices and on the ground near infested trees. Other bark beetles often attack trees whose tops were previously infested by pine engravers. Foliage begins fading within a few weeks after attack; most killed trees are completely faded by late summer or early fall, but some may not fade until the following spring. Unsuccessful current attacks (severity code 1) cannot be observed. Pine engraver beetle does not cause topkill (severity code 5).

Three to four egg galleries branch from a central nuptial chamber. Egg galleries generally run with the grain of the wood, and are typically 5-10 inches (13-25 cm) long. There may be from one to five generations per year, depending on local weather.

FIR ENGRAVER (*Scolytus ventralis*) Code 0 7 *

Hosts: True firs; prefers weakened trees or fresh slash.

Evidence of Infestation: The earliest evidence of attack are the tiny holes (3/32 inches, or 2 mm, in diameter) made in the bark by adult beetles. Pitch tubes are not formed. Reddish-brown boring dust may sometimes be seen in bark crevices and in cobwebs. As twigs and branches become girdled, foliage fades in color, forming "flagging". Numerous attacks over the entire bole may girdle a tree in one season; fading then becomes uniform throughout the crown. Lesser degrees of attack result in top killing or destruction of scattered patches of cambium. This bark beetle is commonly associated

with root disease centers. Unsuccessful current attacks (severity code 1) cannot be observed. Fir engraver beetle readily cause topkill (severity code 5).

Egg galleries run horizontally across the grain of the bole, and are 2-6 inches (5-15 cm) long. These galleries are deeply scored into the sapwood. Larval mines extend vertically, at right angles to the egg galleries. Most populations require one year per generation, though two years may be required in colder areas.

SILVER FIR BEETLE (*Pseudohyesinus sericeus*) Code 0 8 *

Hosts: True firs, Douglas-fir, and western hemlock; prefers weakened trees or fresh slash.

Evidence of Infestation: Silver fir beetles make small, inconspicuous entrance holes. Small amounts of reddish boring dust can sometimes be found under each entrance hole and around the base of an infested tree. Foliage of attacked trees turns yellow, then bright red, and then gradually brown, remaining on the tree about 2 years. Unsuccessful current attacks (severity code 1) not readily observed. Silver fir beetle does seldom causes topkill (severity code 5).

Galleries are similar to the fir engraver (egg galleries cutting across the grain of the wood and larval galleries mined at right angles to the egg galleries), except they are not deeply scored into the sapwood. One generation per year was reported in Oregon, while the life cycle took two years to complete in Northern Washington.

RED TURPENTINE BEETLE (*Dendroctonus valens*) Code 0 9 *

Hosts: All western pines (occasionally attacks spruce and larch); prefers weakened trees or fresh stumps.

Evidence of Infestation: Attacks are usually concentrated in the basal 6 ft. of the tree, but occasionally attacks may extend up to 12 feet (4 m). Pitch tubes may be as large as 2 inches (5 cm) in diameter, and are usually pinkish-red in color. Boring dust and small pitch pellets can sometimes be found at the bases of infested trees. Pitch tubes will remain white-yellow (no boring dust) in an unsuccessful current attack. Red turpentine beetle does not cause topkill (severity code 5). Red turpentine beetle attack is often not fatal, though it may precede or accompany attacks by other bark beetles such as western pine beetle. If an infested tree dies, its needles fade to yellowish-green then through shades of yellow and sorrel to red.

Galleries are generally vertical or cavelike and are usually packed with granular, reddish, pitchy borings and frass. Larvae feed together, producing a cavity which ranges in size from 0.1 to 1.0 sq. ft. (93-930 sq. cm.) rather than individual larval mines. There are usually one or two generations per year.

GUIDES FOR IDENTIFICATION OF DEFOLIATING INSECTS

(Codes 1 0 * - 1 9 *)

WESTERN BLACKHEADED BUDWORM (*Acleris gloverana*) Code 1 1 *

Hosts: Hemlock, spruce, true firs, and Douglas-fir.

Evidence of Infestation: Damage is confined to the new foliage and resembles western spruce budworm damage. In the spring, young larvae mine and kill expanding buds; older larvae web needles together to form a loose shelter and feed primarily on new foliage. Trees may be killed, top-killed, or severely weakened and thus susceptible to bark beetle attack. The blackheaded larvae have pale yellow bodies and grow to 1/2-5/8 inches (12-16 mm) in length. Sporadic outbreaks have occurred in Oregon and Washington.

DOUGLAS-FIR TUSSOCK MOTH (*Orgyia pseudotsugata*)- Code 1 3 *

Hosts: Douglas-fir, grand fir, white fir, and subalpine fir; may feed on other conifers when intermixed with firs.

Evidence of Infestation: Larvae prefer new needles, but will consume older needles; trees are often stripped from the top down. Newly expanded needles that are partially consumed die and turn red, giving stands a reddish hue until the needles drop. Tree tops may have white caps due to silk from dispersing larvae. Young larvae are grayish with long hairs. Older larvae are orange-brownish with dense brushes of hairs on their backs and short hairs radiating from red "buttons" along their bodies; fully grown larvae are 1 to 1-3/16 inches (25-30 mm) long. From August to May, egg masses that are coated with hairs may be found on branches, twigs, and tree trunks.

LARCH CASEBEARER (*Coleophora laricella*) Code 1 4 *

Host: western larch

Evidence of Infestation: Most of the damage caused by the casebearer occurs when the mature larvae feed on new foliage in the early spring. Heavily defoliated trees may appear reddish or scorched as the new needles die. Eggs hatch in mid to late summer, and larvae initially mine needles. Later each larva cuts off part of a hollowed-out needle and slips inside it, so that the needle case protects most of its body as it feeds. The half-grown larvae spend the winter in needle cases on larch twigs, and complete their life cycle during the following spring and summer. Mature larvae are 1/5-1/4 inches (5-6 mm) long.

WESTERN SPRUCE BUDWORM and MODOC BUDWORM

(Choristoneura occidentalis and C. retiniana) Code 1 5 *

Hosts: True firs, Douglas-fir, western larch, and spruce.

Evidence of Infestation: In early spring, larvae mine needles or buds. Later, BY N make loose webs on the newly expanded shoots and feed on new foliage. Back feeding on older foliage or on non-preferred species such as pine may occur if new foliage becomes scarce. Young larvae are light green with dark brown heads. Older western spruce budworm larvae and pupae are brown with ivory- colored spots, while older modoc budworm larvae and pupae remain greenish. Full-grown larvae are 1 to 1-1/4 inches (25-32 mm) long. Sporadic outbreaks of western spruce budworm have occurred throughout eastside forests in Oregon and Washington; occasional modoc budworm outbreaks have been reported in the Warner Mountains of Oregon and California.

SAWFLIES (Neodiprion, Pristiphora, Anoplonyx) Code 1 7 *

Hosts: Neodiprion - pines, true firs, spruce, Douglas-fir
Pristiphora - larch
Anoplonyx - larch

Evidence of Infestation: Sawfly larvae are hairless and have six or more pairs of prolegs on their abdomens. Full-grown larvae are 5/8-1 inch (16-25 mm) long. Younger Sawfly larvae often feed in clusters on needles. Neodiprion larvae feed primarily on older foliage, and are rarely found on the current year's foliage. Pristiphora feed at first on the edges of needles on elongating shoots, and then later move to needle clusters on older twigs. Anoplonyx larvae feed heavily on foliage from mid-July to late August.

NEEDLE AND SHEATH MINERS (Coleotechnites, Contarinia, Taniva, Zelleria) Code 1 8 *

Hosts: Coleotechnites - Douglas-fir
Contarinia - most important species on lodgepole pine and ponderosa pine, less important species on other pines, spruce, true firs, and cypress
Taniva - spruce
Zelleria - most 2- and 3-needle pines

Evidence of Infestation: These larvae feed inside a needle or needle sheath. Mined needles turn yellowish, dry, and fall off twigs; entrance holes are usually visible, and the mined needles appear hollow when held up to the light. Coleotechnites mine needles and have caused extensive outbreaks in lodgepole stands. Contarinia form gall-like swellings on new Douglas-fir needles; heavy infestations may cause significant defoliation and twig die-back. Taniva mine spruce needles during the summer; the hollowed needles are attached to the twig in funnel-shaped, frass-filled web. Zelleria mine needle sheaths in the spring, weaving silken webbing around needle bases and causing the needles to droop and then die.

GUIDES FOR THE IDENTIFICATION OF OTHER INSECTS

(Codes 2 0 * - 2 2 *)

SHOOT MOTHS (*Eucosma*, *Rhyacionia*) Code 2 1 *

Hosts: Pines, especially ponderosa pine

Evidence of Infestation: *Eucosma* larvae feed within the pith of new terminal and lateral shoots from May until August. Terminal shoots become thickened and have shorter needles that are bunched together like a shaving brush; terminal shoot growth is usually reduced, but mortality is not common. Lateral shoots that are infested with *Eucosma* often die. Exit holes from the pith can be seen in late summer.

Rhyacionia larvae mine buds and new shoots under the bark but rarely enter the pith. They cover shoots with matted frass, dead needles, and webbing. Infested shoots are shortened and turn yellow, then brown.

WEEVILS (*Pissodes*, *Magdalis*, *Scythropus*) Code 2 2 *

Hosts: *Pissodes* - pines and spruce

Magdalis, *Scythropus* - pines, especially ponderosa and lodgepole pine

Evidence of Infestation: Weevils can infest shoots, roots, twigs, or needles. While many *Pissodes* species attack the bole and root collars of dying trees, *P. strobi* girdles and often kills the current and lateral terminal shoots of young spruces and pines. Wood-chip cocoons are made in the phloem and pith of shoots. Shoots damaged by *Pissodes* turn reddish and curl; exit holes are usually visible. *Magdalis* and *Scythropus* adults feed on needles during the spring and early summer. *Magdalis* adults generally eat holes through needles, while *Scythropus* adults usually eat chunks out of needle edges and may cause needle death.

WOOD BORERS (*Cerambycidae*, *Buprestidae*) Code 2 3 *

Hosts: Most conifers, many hardwoods

Evidence of Infestation: Although some wood borers kill weakened trees, most attack trees that have been recently killed by other agents, such as bark beetles, fire, etc. Larval galleries of some species start in the cambium and later move inwards to the sapwood and heartwood; other species construct larval galleries entirely in the cambium. When wood borers attack after bark beetles, the wood borer galleries may overrun and obscure the initial bark beetle galleries.

Cerambycids are also known as long-horned beetles because the adults have very long antennae, and as round-headed borers because adults make round exit holes when leaving a tree. Larval galleries are filled with coarse, excelsior-type frass.

Buprestids are also known as metallic borers because most adults are shiny or metallic-colored, and as flat-headed borers because the exit holes made by adults are flattened ovals. Larval galleries are filled with fine boring dust that is often packed in concentric arcs.

BALSAM WOOLY ADELGID (*Adelges piceae*) Code 2 4 *

Hosts: true firs

Evidence of Infestation: This small, sucking insect feeds on stems, branches, or twigs of true firs. Heavy feeding causes galls or swellings at twig tips and dense, red wood (similar to compression wood) on the stem. Stems of heavily attacked trees appear white because of the white, cottony masses that surround the adults.

GUIDES FOR IDENTIFICATION OF DWARF MISTLETOE

(Code 3 0 *)

DWARF MISTLETOE (*Arceuthobium* spp.) Code 3 0 *

Hosts: Ponderosa and lodgepole pines, western larch, true firs, hemlock and Douglas-fir

Evidence of Infestation: Dwarf mistletoes are parasitic plants that depend on conifer hosts. Their modified root system is embedded in bark and wood tissues. Their aerial shoots are basically reproductive structures. Although they do contain chlorophyll and manufacture some carbohydrates, Most of their carbohydrates and all of their water and minerals come directly from the host. Dwarf mistletoe infection is characterized by reduction in growth. Height growth is generally more seriously affected than diameter growth.

Mistletoe plants are small, ranging in height from one-half inch (1 cm) or less on Douglas-fir to 3 inches (8 cm) or more on ponderosa pine. Branches swell and become spindle-shaped at the point of initial infection. However, the most conspicuous symptom is formation of witches' brooms, which develop within a few years of infection. Brooms are spherical clumps of abnormal branch and twig

growth, usually exhibiting lighter colored and smaller needles than normal branches. Dwarf mistletoes are generally host specific.

Mistletoe plants are either male or female; both sexes may be found on the same host tree. The pathogen spreads by sticky seeds "shot" from the female mistletoe plant; most seeds (90 percent) land within 50 feet. After an infection is established, it takes 3 to 4 years to reach maturity. Rate of spread within an even-storied stand is about 2 feet per year.

Severity rating for dwarf mistletoe is coded 0 through 6 according to the following system:

INSTRUCTIONS

EXAMPLE

STEP 1. Divide live crown into thirds

If this third has no visible infections, its rating is (0).

STEP 2. Rate each third separately. Each third should be given a rating of 0, 1 or 2 as described below.

If this third is lightly infected, its rating is (1).

(0) No visible infections

(1) Light infection (1/2 or less of the total number of branches in the crown third are infected)

If this third is heavily infected, its rating is (2)

(2) Heavy infection (more than 1/2 of total number of branches in the crown third are infected).

STEP 3. Finally, add ratings of thirds to obtain rating for total tree.

The tree in this example will receive a rating of $0 + 1 + 2 = 3$.

GUIDES FOR IDENTIFICATION OF STEM CANKERS

(Code 3 6 * - 4 5 *)

Some fungi invade stems and branches and cause localized infection in the bark and underlying woody tissues; these necrotic lesions are called cankers. The initial symptom is a localized swelling; over time, this tissue dies and contracts, leaving sunken dead areas known as cankers. Cankers on the main stem may kill the tree by girdling; those on branches usually cause only flagging. Cankers are often bordered by ridges of callus tissue. Field identification of cankers is based on host species and shape of stem swelling, as shown in the following key.

Field Key to Stem Cankers

A. Pines

1. Five-needle pines - spindle or diamond-shaped swelling with yellow- green margins.

White pine blister rust (Code 3 6 *)

2. Two- or three-needle pines -

- a. Slight swellings longer than wide (2 or 3:1), resin-soaked orange spores present in early summer. **Comandra rust** (Code 4 2 *)

- b. Slight swelling very long and narrow (10:1 length to width); resin- soaked wood with bark missing from canker face, roughly diamond- shaped. **Stalactiform rust** (Code 4 3 *)
- c. Pronounced swellings globose, as wide as long (1:1). **Western gall rust** (Code 4 1 *)
- d. Slight swelling elliptical, not long and narrow. Resin-soaked canker face with intact bark, blue-black stain of sapwood and heartwood. **Atropellis canker** (Code 4 4 *)

B. Douglas-fir and true firs

Cankers on Douglas-fir and true firs are frequently caused by **Cytospora** and **Phomopsis** (Code 4 5 *)

WHITE PINE BLISTER RUST (*Cronartium ribicola*) Code 3 6 *)

Hosts: all 5-needle pines

Evidence of Infection: Symptoms may include: discolored areas of bark, with the outer edges of the discoloration yellowish-green to orange; shallow blisters on the bark, which may contain masses of orange aeciospores; spindle or diamond-shaped swelling of the stem or branches accompanied by scaly lesions and black pycnial scars; copious resin exudation from ruptured bark in area of infection; and red "flagging" of foliage on girdled tops or branches.

WESTERN GALL RUST (*Endocronartium harknessii*) Code 4 1 *

Hosts: 2- and 3-needle pines

Evidence of Infection: Western gall rust is distinguished by its round or pear-shaped galls that may grow to 12 inches (30 cm) in diameter. Galls continue to grow each year until they eventually girdle the branch or stem. Stem infections may result in "hip cankers" that remain active for up to 200 years before the stem is completely girdled.

COMANDRA BLISTER RUST (*Cronartium comandrae*) Code 4 2 *

Hosts: 2- and 3-needle pines, especially lodgepole pine and ponderosa pine

Evidence of Infection: Wood in the canker area is resin-soaked, and copious amounts of resin may flow from the canker. Other symptoms are similar to those for white pine blister rust on white pines.

STALACTIFORM RUST (*Cronartium coleosporioides*) Code 4 3 *

Hosts: lodgepole pine, Jeffrey pine, ponderosa pine

ATROPELLIS CANKER (*Atropellis piniphila*) Code 4 4 *

Hosts: Lodgepole pine

Evidence of Infection: Wood in the canker area is resin-soaked and has a blue-black stain. Black, disc-shaped fruiting bodies that are 1/16-3/16 inches (2-5 mm) in diameter may be visible on the canker surface. This pathogen is more likely to be found in cool, moist sites.

CYTOSPORA or PHOMOPSIS - Code 4 5 *

Hosts: Cytospora - true firs, rarely Douglas-fir

Phomopsis - Douglas-fir

Evidence of Infection: Cytospora usually attacks weakened trees, especially branches previously infected with dwarf mistletoe. Dead branch-tips are the most visible symptom. Phomopsis canker primarily affects young trees, often killing trees less than 3 inches (8 cm) in diameter and causing branch flagging on older trees.

GUIDES FOR IDENTIFICATION OF STEM AND BUTT DECAYS

(Code 4 6 * - 4 9 *)

The presence of any kind of conks or punk knots on trees, living or dead, indicates serious defect and damage; in fact, they are the most serious of any of the defect or damage indicators. Always code the presence of conks on living trees. Conks may be found on the ground near the base of a tree, on the bole, or on a branch. Punk knots may have either a sunken or swollen appearance, and sometimes must be chopped out for identification. Occasionally the bark has grown around or over them to the extent they are very difficult to detect. Absence of conks does not mean that a tree is sound. Some fungi rarely produce conks on living trees, although fruiting may be prolific after the tree dies.

There are three genera of wood decay fungi of major importance in the Pacific Northwest Region. These are *Echinodontium*, *Phellinus*, and *Phaeolus*, and are identified as follows:

Evidence of Infection: Cankers have resin-soaked wood. In Jeffrey pine, stalactiform rust is most often found in lower crowns.

Field Key to Major Wood Decay Fungi

A. Perennial woody conks on the stem

1. Underside and interior of conks are cinnamon-colored; pores are sinuous - **red ring rot** (Code 4 7 *)
2. Underside of conks consists of brittle spines or teeth; interior of conk is red-orange in color - **Indian paint fungus** (Code 4 8 *)

B. Fleshy brown mushrooms are on the butt or on the ground near the butt; old mushrooms are dark brown and crumbly - **brown cubical butt rot** (Code 4 9 *)

RED RING ROT (*Phellinus pini*) Code 4 7 *

Hosts: nearly all conifers

Evidence of Infection: Red ring rot is the number one heartwood decayer in the United States. The shelf-like sporophore is 1-12 inches (3-30 cm) in diameter, dark gray to black on top and cinnamon to yellowish-brown on the underside; it usually occurs at branch stubs. Swollen punk knots filled with cinnamon mycelium may be overgrown and inconspicuous until chopped open. Numerous conks and swollen knots distributed on the bole indicate extensive decay. Punk knots are often present in absence of fruiting bodies; one is just as strong a cull indicator as the other. Red ring rot can be found on all major Pacific Northwest Region conifers and on dead trees as well as living ones.

INDIAN PAINT FUNGUS (*Echinodontium tinctorium*) Code 4 8 *

Hosts: primarily true firs and hemlocks

Evidence of Infection: This fungus attacks heartwood; in advanced stages, the heartwood becomes reddish-yellow to brown and stringy or fibrous. Indian paint fungus enters the trees through dead branchlets. Decay may be stimulated by injury. Sporophores are large woody conks with a black, roughly cracked upper surface; they usually originate from knotholes or branch stubs. Punk knots and sporophores are rusty-red in color when split open. One conk may indicate at least 16 feet of decay in either direction, and two or more conks indicate complete cull.

BROWN CUBICAL BUTT ROT (*Phaeolus schweinitzii*) Code 4 9 *

Hosts: nearly all conifers

Evidence of Infection: Also known as the "velvet-top fungus", *Phaeolus schweinitzii* causes a dry and brittle brown cubical rot in the heartwood and roots of conifers. On soil, the conks are circular with a sunken center and thick, short, central stalk; on boles, the conks are thin brackets. The upper surfaces are velvety and dark reddish-brown in color, while the undersides are yellow-green with a creamy margin when fresh and dark red-brown when old. The presence of conks indicates 8 feet of butt cull for young growth and 16 feet of cull for old growth.

GUIDES FOR IDENTIFICATION OF FOLIAGE DISEASES

(Code 5 5 * - 5 9 *)

ELYTRODERMA NEEDLECAST (*Elytroderma*) Code 5 7 *

Hosts: Primarily ponderosa, Jeffrey, and lodgepole pine; other pines occasionally attacked

Evidence of Infection: Elytroderma causes stunting and reddening of needles, upward curving of branches, defoliation, and witches brooms. Severe infection can lead to tree death. Thin black lines of fruiting bodies are produced on dead and dying needles of the previous year's growth. Infection is usually heaviest in pole and large sapling understories and in dense stands. Most infection occurs at edges of meadows, in wide draws, and on gentle slopes where cool moist air drainage is common.

GUIDES FOR IDENTIFICATION OF ROOT DISEASES

(Code 6 0 * - 6 6 *)

Trees or stands that are infested by root disease often have one or more of the following characteristics:

1. Crowns are thin, with decreased shoot growth and discolored (usually yellowish) foliage.
2. Pockets of mortality occur, including down, broken, recent dead and older dead trees within proximity to each other.
3. Resin exudes from roots and root crowns, often accompanied by fungal structures, stain, or decay (see codes 60-64 for descriptions).
4. Trees have been or are currently being attacked by bark beetles, especially the Douglas-fir beetle and the fir engraver.

ANNOSUS ROOT ROT (*Heterobasidion annosum* or *Fomes annosus*) Code 6 1 *

Hosts: Severe damage: grand fir, white fir, Pacific silver fir, mountain hemlock, and western hemlock (over 150 years old) may be severely damaged. Moderate damage: ponderosa pine, lodgepole pine, and western hemlock (under 150 years old). Other western conifers are seldom damaged.

Evidence of Infection: Crown symptoms (described above, with the exception that hemlock rarely shows crown symptoms) and resin-soaked streaks in root and root crown sapwood may indicate presence of annosus root rot. Root surfaces may have small, white pads of fungal growth. Dead trees and stumps may have yellow, spongy decayed wood with white pockets and black specks; decayed wood often separates along growth rings, showing small (1-2 mm) pits on only one side of the rings. Such decay found in trees and stumps nearby is an indicator of annosus root rot in symptomatic trees; look for resin-streaking in sapwood. Conks are occasionally produced at the base of dead trees under the duff.

They are white, pored and woody or leathery, usually flat on bark with a brown irregular edge. If the conk is somewhat shelf-like, the upper surface is concentrically ridged and dark brown.

SHOESTRING ROOT ROT (*Armillaria ostoyae*) Code 6 2 *

Hosts: Severely damaged: Douglas-fir, grand fir, white fir. Moderately damaged: other true firs, pines, hemlocks, spruces, and western redcedar. Other conifers are seldom damaged.

Evidence of Infection: Crown symptoms are as described above, and basal resinous is often seen on the outside of bark at the root crown. Mycelial fans are generally present beneath the bark at the root crown; these fans are cream to white, 1/16-1/4" (2-6 mm) thick with fanlike, radiating ridges. The stringy yellow-white sapwood decay is often not sufficiently advanced at the root crown for proper diagnosis. Black zone lines traverse the decay in irregular patterns and aid considerably in identification of early decay. Fruiting bodies are honey-colored mushrooms that grow 3-10 inches (8-25 cm) tall, appearing in the fall. Rhizomorphs -- dark brown or black, flattened strands of fungal tissue -- sometimes can be found growing along root surfaces or through soil.

BLACK STAIN ROOT DISEASE (*Ceratocystis* [*Verticicladiella*] *wagnerii*) Code 6 3 *

Hosts: Severely damaged: Douglas-fir. Moderately damaged: ponderosa pine, lodgepole pine, western hemlock. Seldom damaged: western white pine, mountain hemlock.

Evidence of Infection: Crown symptoms are as described above. Distinct vertical black streaks in root and root crown sapwood follow annual rings. Black stain can be distinguished from blue stain by the pattern of stain: black stain follows the annual rings while blue stain produces wedge-shaped stain areas that point inward toward the

pith. Cut into root or base of bole to observe pattern of stain in sapwood if black stain is suspected.

LAMINATED ROOT ROT (*Phellinus weirii*) Code 6 5 *

Hosts: Severely damaged: Douglas-fir, mountain hemlock, grand fir, white fir, and Pacific silver fir. Moderately damaged: western hemlock, larch, spruce, other true firs. Pines and cedars are seldom damaged.

Evidence of Infection: Crown symptoms are as described above. A thin layer of white or cream-colored mycelium on the outside of roots is a good indicator of early disease. Decay of root sapwood and butt heartwood is rapid. Growth rings separate into sheets, and small pits (1-2 mm) are visible on both sides of the rings. Rusty-reddish colored hairs visible between separated sheets of decayed wood.

PORT-ORFORD-CEDAR ROOT ROT (*Phytophthora lateralis*) Code 6 6 *

Hosts: Port-Orford-cedar

Evidence of Infection: Infected trees decline rapidly, with crowns fading from yellow through red and brown. This fungus grows from the roots up through the root crowns and lower stems. Infected phloem is stained cinnamon-brown.

GUIDES FOR IDENTIFICATION OF ANIMAL DAMAGE

(Code 7 0 * - 7 8 *)

Mountain Beaver - Code 7 1 * - Seedlings and saplings are severed near the ground or saplings are stripped of lateral branches. Tooth marks visible, Burrows with loose soil in area. Westside of Washington and Oregon.

Livestock - Code 7 2 * - Livestock may trample seedlings and saplings. This damage is serious when potential crop tree stoking has been reduced below established minimums.

Big game (deer, elk) - Code 7 3 * - Deer and elk will clip terminal and lateral shoots within their reach -- often a distinct "browse line" is visible. Droppings and tracks may be present near damaged trees.

Porcupines - Code 7 4 * - Porcupines are a great nuisance in young stands of fast-growing timber because they seem to favor the very best trees. They may climb 20-30 feet to girdle the stem in the upper portion of the crown. Large bark chips may be found at the base of the tree. This damage may kill the top, thus deforming the tree and reducing the growth rate.

Pocket gophers - Code 7 5 * - These rodents feed on seedling roots, weakening or killing the trees. Rounded mounds of soil and/or ridges in the soil caused by burrowing are signs of pocket gopher activity.

Mice or voles - Code 7 5 * - Mice and voles sometimes girdle the stems of small trees, and may cause heavy damage in areas with thick grass cover. Signs of mouse activity include runways that are about 2 inches (5 cm) wide and cleared of vegetation, piles of droppings, and small caches of clipped grass.

Rabbits or hares - Code 7 5 * - Stems and lower branches may be stripped or girdled by rabbits and hares. Damage occurs only as high on the stem as these animals can reach when standing on their hind legs. Small branches may be clipped off with clean, slanted cuts. Droppings and tracks may be visible near damaged trees.

Tree squirrels - Code 7 5 * - Needle fascicles from cone-bearing portions of a tree are clipped and left scattered on the ground within the drip line of the tree's crown.

Beaver - Code 7 6 * - Saplings and poles are severed near the ground, leaving wide tooth marks on the remaining stumps. Damage occurs near creeks or ponds, where beaver dams are usually evident.

Bears - Code 7 7 * - Bark is removed from the lower 1/3 to 1/2 of the stem, and bark strips are usually present near the base of the tree. Vertical striations are often visible on the cambium.

Human-caused (other than logging) - Code 7 8 * This category includes vandalism, damage by vehicles, etc.

GUIDES FOR IDENTIFICATION OF WEATHER DAMAGE

(Code 8 0 * - 8 8 *)

Wind - Code 8 1 * - Wind damage usually occurs as blowdowns, where trees are uprooted and blown over. This may occur in residual stands after logging or following a windstorm. Tops may be broken out of trees, but often where this happens it is due to weakness from rot.

Snow or ice - Code 8 2 * - Damage is characterized by breakage due to heavy loads of snow or ice on limbs, or bending in the case of seedlings and saplings. Such bent-over trees seldom recover, and the damage is serious. This code also includes frost cracks, which usually occur during extremely low temperatures. When there is a sudden drop in temperature, the outer wood of a tree cools and shrinks at a faster rate than the inner wood, causing a split to occur. Frost cracks tend to run up and down on the same side of the tree. These cracks provide avenues for infection as well as damage to the wood, but often frost cracks will close and heal over, and the tree may remain sound.

Frost damage - Code 8 3 * - Frost damage to foliage usually occurs when new foliage or shoots are exposed to extremely cold temperatures. The foliage appears blighted, and may wilt or turn red; generally only the needle tips are tinged. Frost damage is known mostly by its occurrence in a localized area at a given time.

Winter desiccation - Code 8 4 * - Winter winds may lead to severe drought for exposed trees that are not able to replace water lost through transpiration. Also known as parch

blight, this condition causes foliage to turn brown in late winter or early spring and may lead to shoot die back or tree death.

Moisture stress - Code 8 5 * - Trees undergoing moisture stress may lose needles, grow slowly, wilt, and eventually die. These weakened trees are often attacked by other pests.

Sunscald - Code 8 6 * - Rapid increases in stem temperature may kill plant tissue. When this damage occurs, it is often found on the south or west sides of tree boles.

Lightning - Code 8 7 * - Lightning can sometimes kill the tree as well as shatter the wood, create an open wound through which infection can enter, retard growth, etc. Lightning scars tend to spiral around the tree. Trees that survive lightning strikes are often attacked by bark beetles, decay fungi, or other pests.

GUIDES FOR IDENTIFICATION OF OTHER DAMAGE

(Code 9 0 * - 9 4 *)

Logging - Code 9 1 * - Logging damage appears as trunk and basal scars or wounds caused by falling trees, equipment scraping along the trunk, or logs being skidded against the base of the tree. During thinning, leave trees may suffer damage. Damage to trees which have been hit with hypo hatchet should also be recorded.

Fire damage - Code 9 2 * - Usually fire damage occurs as basal scars. The charred or blackened wood will remain visible for many years. While fire scars may predispose trees to attack by bark beetles or serve as an avenue for infection. Little more than the first 4 feet may be cull in fire-adapted tree species such as ponderosa pine.

Improper planting technique - Code 9 3 * - The tap roots of improperly planted seedlings usually are bent sharply (or broken), giving them hook- or J-shaped appearance.

Air pollution injury - Code 9 4 * - Damage occurs when toxic gases are emitted from smelters, reduction plants, or coal-burning industries and power plants. The foliage usually absorbs gases for a prolonged period before injury becomes visible. Symptoms and severity of damage vary between tree species, concentrations and types of gases, duration of exposure, and distances from the source. Conifer needle discoloration starts at the tips, while broad-leaved foliage is affected first in tissues between veins, giving leaves a mottled appearance. Foliage, buds, branches, and entire trees may be killed; damage sometimes occurs over an extensive area.

Appendix F

Diameter Irregularities

Irregularities at 4.5 feet

Irregularities will be recorded which give accurate representations of tree size and volume. When a bole form irregularity occurs at the normal dbh point, field crews will adjust the point of measurements and note the circumstances in remarks. For any dbh not measured at 4.5 feet due to an irregularity, note the height it was measured at and explain the reason in remarks, i.e. "dbh at 5.3 - limb". All nails will be positioned at the actual level of measurement. Measure diameters directly and do not attempt to compensate for missing bark and/or wood.

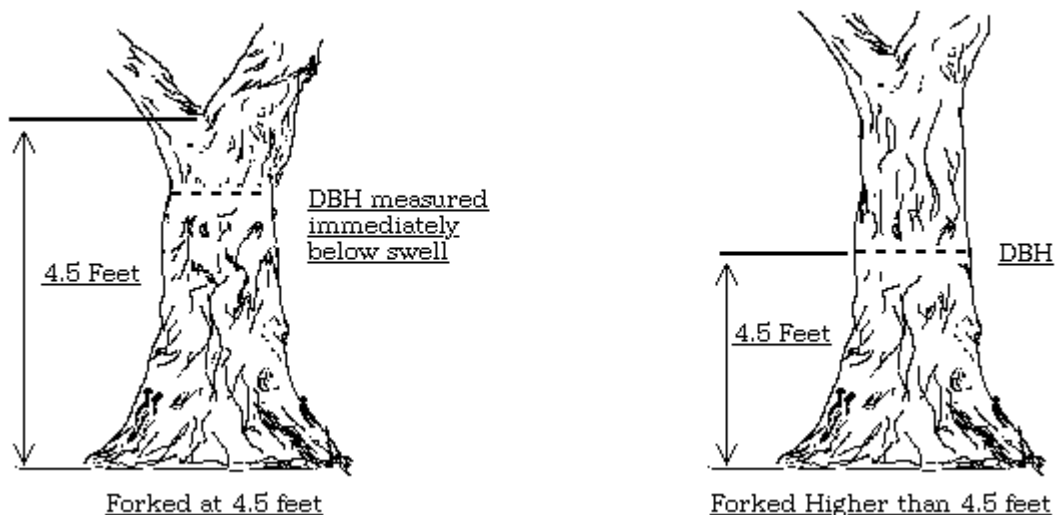
Major localized irregularities such as limbs, burls, fire scars, catfaces, swellings, etc., will require that dbh be marked and measured immediately above the irregularity at the point where it ceases to affect normal stem form.

If the irregularity extends a considerable distance up the bole but the stem form below the normal dbh point is unaffected, take diameter immediately below the irregularity as near to 4.5 feet above the ground as possible. Do not measure diameters less than 3.0 feet above the ground.

Non-localized irregularities such as lightening scars, cracks, seams, and logging scars sometimes extend over so much of the bole length that adjustment above or below is impossible or gives an unrealistic representation of tree size. In this circumstance, mark and measure dbh at the normal point 4.5 feet above the ground unless another major localized irregularity occurs there.

Butt swell extending up the stem 4.5 feet or more will require that diameter be measured at a point immediately above the swell where the stem resumes normal form. This can usually be accomplished by hooking the end of the diameter tape on a long stick and pulling it around the tree. Butt swell in some trees may be so extreme that no direct measurement of dbh is obtainable. To obtain an indirect measurement of dbh follow the procedure given below. This method should only be used in extreme circumstances and must be clearly described in remarks.

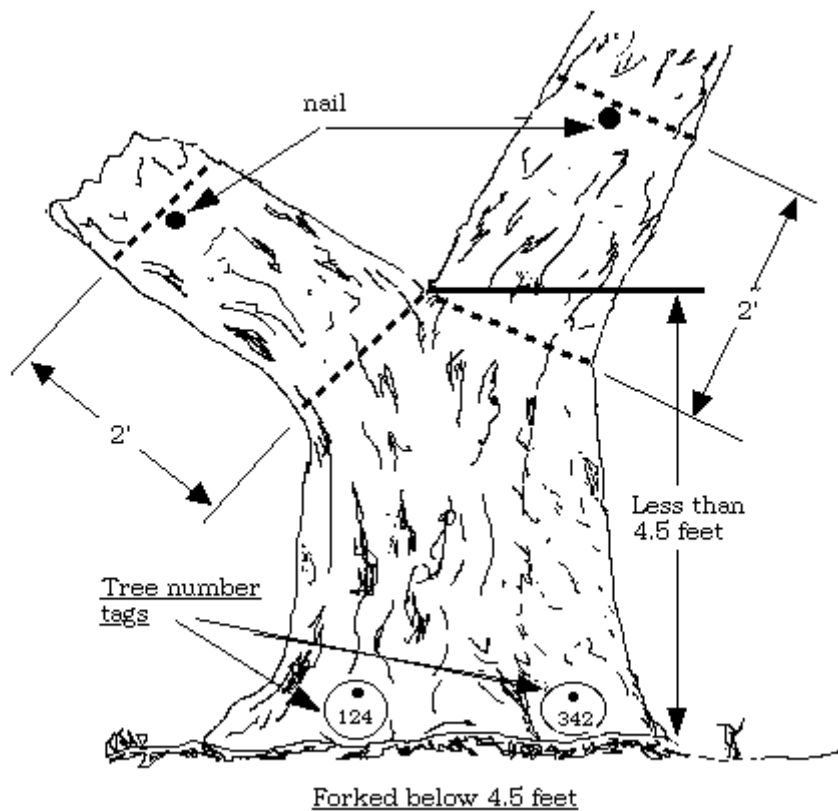
Trees forked at or above 4.5 feet: The open crotch of the fork is at or above 4.5 feet, will be recorded as single trees. Mark and measure dbh immediately below any swelling but as near to the normal point as possible.



Trees forked below 4.5 feet: The open crotch of the fork begins below 4.5 feet; will be tallied and recorded based on the stem diameter(s) of the forks 2 feet above the beginning of the crotch. If the forks appear to be trees which have grown together refer instead to "Two trees growing together".

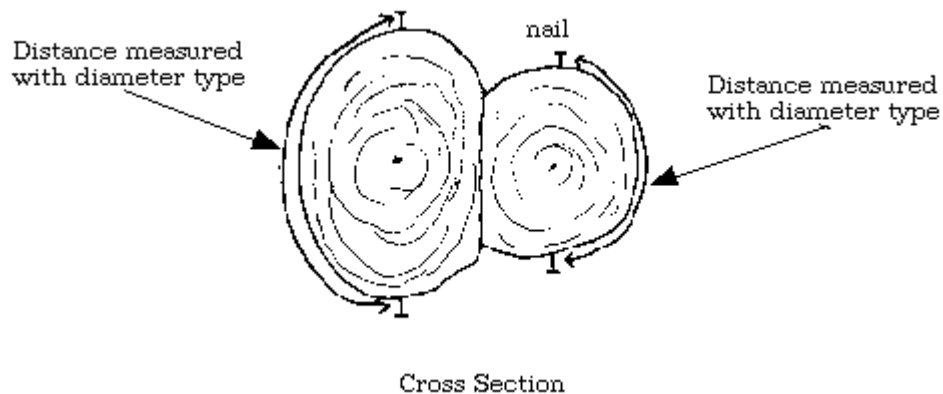
If all the forks are less than 5.0 inches diameter, record them as a single tree according to the tally procedures outlined for the fixed radius plot. Record the diameter of the largest fork and use it to define the tree size class (seedling or sapling).

Conifers forked 5.0 inches diameter or larger will be recorded as separate trees according to the tally procedures outlined for that diameter. Each tallied fork 5.0 inches diameter or larger will be recorded separately. Any forks less than 5.0 inches diameter that are also present will not be tallied. Identify each tallied fork with separate tree number tags on the sides of the tree where the forks occur (see drawing). Note in remarks the words "fork" followed by the tree number of the fork with the largest diameter.



Trees growing together sometimes give the appearance of a forked tree. This situation can usually be recognized because of the seam which develops where the two trees have joined. This seam should extend very close to the ground.

Trees which have grown together will be recorded as separate stems and dbh will be marked and measured at the normal point 4.5 feet up the stem. Determine dbh by driving in two nails opposite each other on the center line of each bole's circumference. Measure the distance between the nails with a diameter tape and double it to determine dbh. Note the situation clearly in remarks (see diagram).



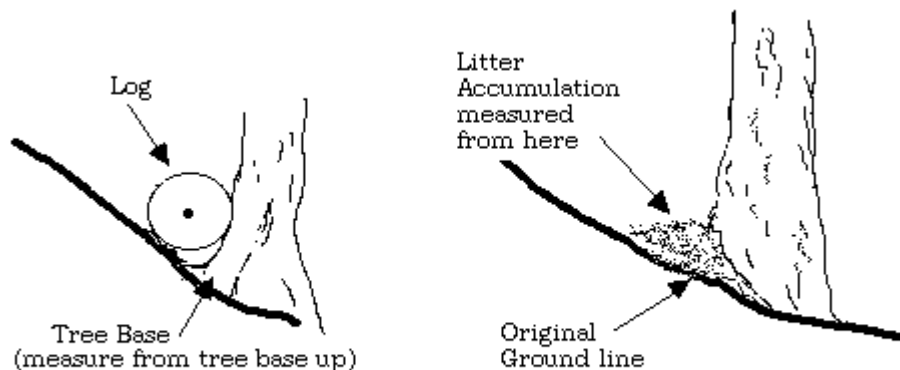
Broken or barber-chaired trees should have dbh marked and measured at the normal position 4.5 feet up the bole if possible. If the stem is broken below 4.5 feet measure the stem as a stump. The down portion of the tree will be considered down woody material. If the stem is broken at or above 4.5 feet, measure diameter above or below the break, whichever gives the best representation of actual stem size.

Dead trees will have actual diameters recorded. Do not reconstruct diameter to account for missing bark or rotten wood. Record in the actual diameter present with no adjustments made for minor irregularities. When major deformities are present at 4.5 feet adjust the measurement point as specified in the preceding examples.

Adjusting the Level of DBH Measurement

The objective is to obtain a measurement at a level 4.5 feet above the ground line on the uphill side of the tree. Accumulations of litter and debris will be considered part of the ground line based on the extent to which they have become incorporated into the ground.

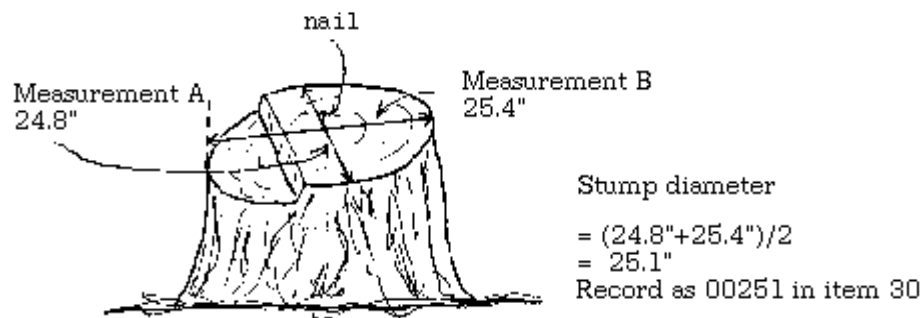
1. Recent debris such as limbs and small pieces of wood should be moved aside. Do not, however, dig down into the duff layer. Loose duff should be stepped on and compressed.
2. Larger pieces should be compensated for if the tree base can still be recognized.
3. Do not compensate when the debris accumulation has been in place for so long that it has become the new ground line.



A nail may be used to define the ground line if necessary

Stump Diameter

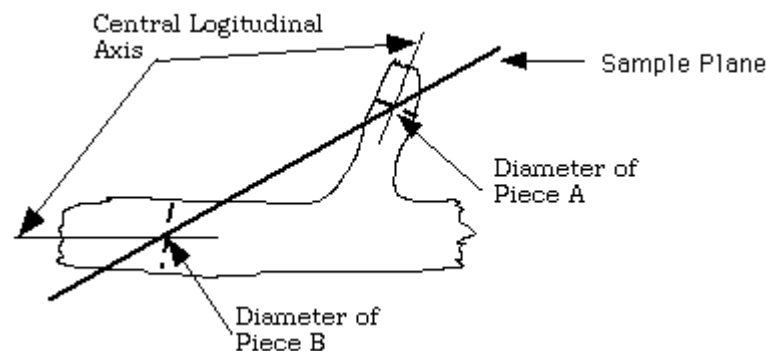
Average the two measurements and record the result to the last whole 0.1 inch increment (see diagram).



Occasionally the top of the stump may be very irregular or have material on it making cross measurements impractical. When this is the case, a diameter tape may be used to measure around the stump just below the cut level. Remember to either remove the bark or subtract its thickness when using this method.

Diameter at Point Plane Intersection

Diameter is recorded for all down woody pieces tallied on the transect samples. Field crews will determine and record the diameter of the piece at the point where its central longitudinal axis is intersected by the sample plane. See diagram below:



Height for Live and Standing Dead Trees

Total height for live trees and standing dead trees is measured from the ground level at the base of the tree to its highest point.

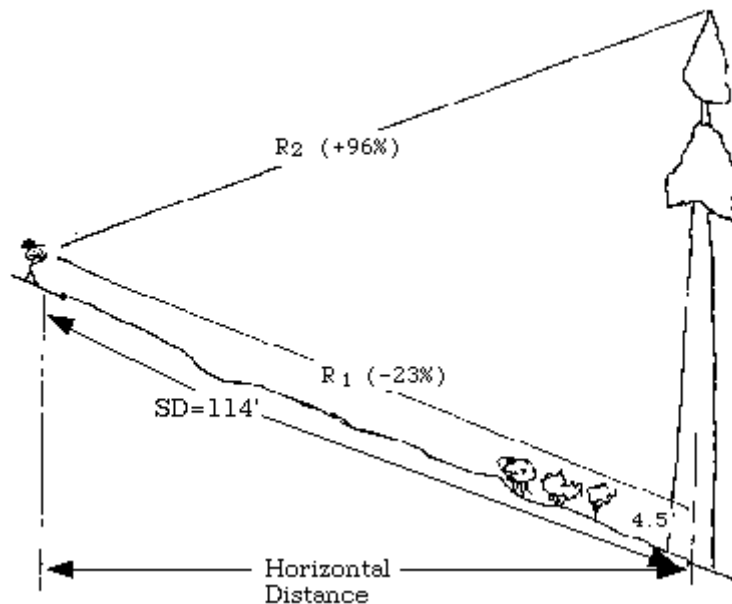
The following diagram is an example of a total height calculation. Note that the observer has wisely decided to measure the height starting at DBH level and then add 4.5 feet to the measurement.

The basic formula for calculating heights is:

$$HT = HD/100 \times (R_2 - R_1) + C$$

Where:

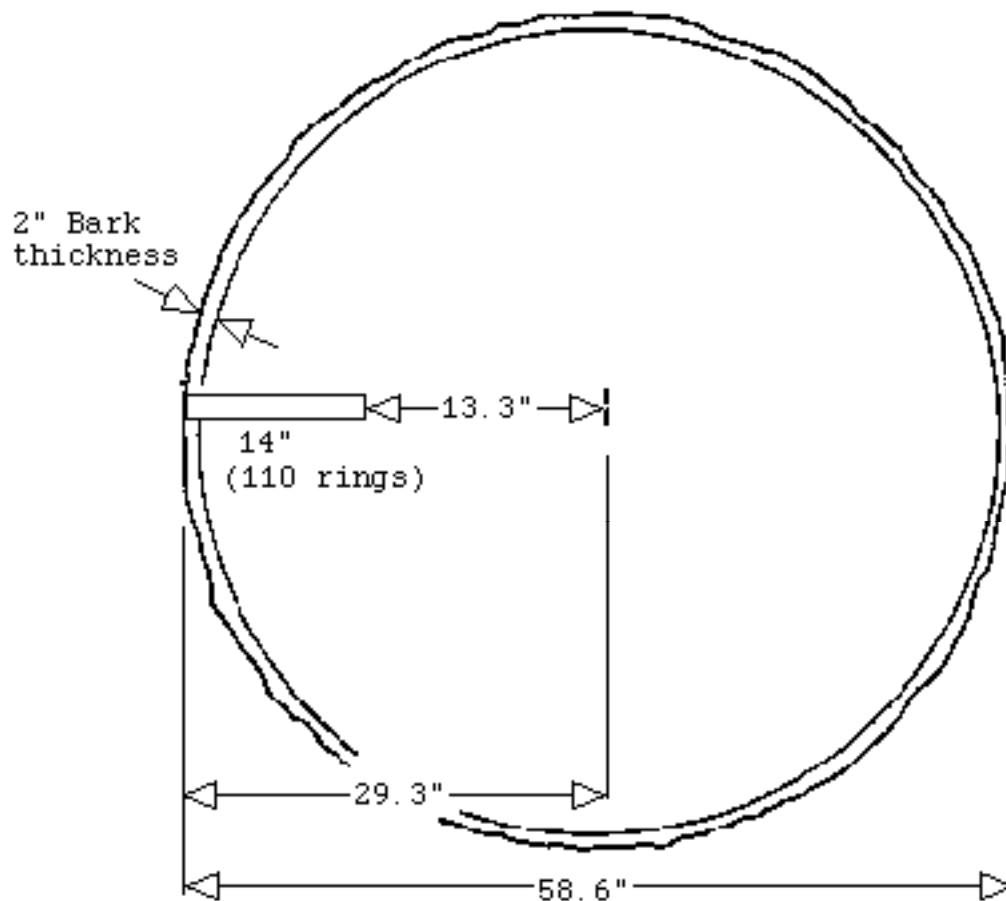
HT - Total Height R_2 - Top % reading R_1 - Bottom % reading
 HD - Horizontal distance from the center of the tree to the observer
 C - Height up the bole to which R_1 is taken (4.5' in this example)



Determining the age of a large tree

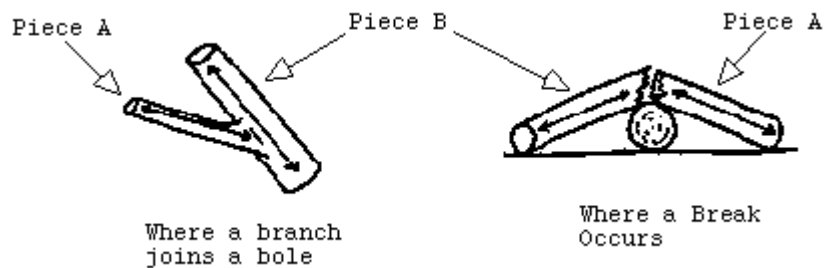
A tree 58.6 inches DBH has a bark thickness of 2.0 inches. A 14.0 inch long core of wood has 110 total rings with 10 rings on the interior two inches.

8.6"/2	= 29.3" (radius of wood and bark)
29.3" - 2.0"	= 27.3 (radius of wood)
27.3 - 14.0"	= 13.3 (distance to center)
10 rings/2"	= 5 rings/inch
5 rings/inch x 13.3"	= 66.5 rings to the center (round to 67)
110 rings on core + 67	
extrapolated rings	= 177 years age Record 177



Defining Down Woody Material

For the purpose of this survey the limits of a piece are defined as points of abrupt physical change or discontinuity. Breakage, advanced decomposition or branching will define the limits of a piece.



Where a piece becomes incorporated into the duff through decomposition.



Appendix G

Indicator List

Appendix H

Site tree

Regional default table for preferred site tree species. Insert Forest preferred site tree species in place of this table when information is available. Site Tree species must have a species equation for site index in order to be included.

Series	1st Choice	2nd Choice	3rd Choice
Douglas fir	Douglas fir	Ponderosa pine	Western Larch
Western hemlock	Western hemlock	Douglas-fir	
Sitka spruce	Sitka spruce	Western hemlock	Douglas fir
Ponderosa pine	Ponderosa pine	Jeffrey pine	Douglas fir
Lodgepole pine	Lodgepole pine		
White fir/Grand fir	Grand fir	White fir	Predominant species
Shasta red fir	Shasta red fir	White fir	Predominant species
Subalpine fir	Engelmann spruce	Western Larch	Western white pine
Pacific silver fir	Pacific silver fir	Noble fir	Western Hemlock
Mt. hemlock	Western hemlock	Western white pine	Predominant species
Cedars	Douglas fir	Western Hemlock	Predominant species
Hardwoods	Red alder	Douglas fir	Predominant species